Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

Foresight and Analysis of Infectious Disease Threats to Virginia's Public Health

March 30th, 2023

(data current to March 23rd – March 29th)

Biocomplexity Institute Technical report: TR BI-2023-43

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About Us

- Biocomplexity Institute at the University of Virginia
  - Using big data and simulations to understand massively interactive systems and solve societal problems
- Over 20 years of crafting and analyzing infectious disease models
  - Pandemic response for Influenza, Ebola, Zika, and others

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Overview

- **Goal**: Understand impact of current and emerging Infectious Disease threats to the Commonwealth of Virginia using modeling and analytics

- **Approach:**
  - Provide analyses and summaries of current infectious disease threats
  - Survey existing forecasts and trends in these threats
  - Analyze and summarize the current situation and trends of these threats in the broader context of the US and world.
  - Provide broader overview of other emerging threats

Key Takeaways

Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

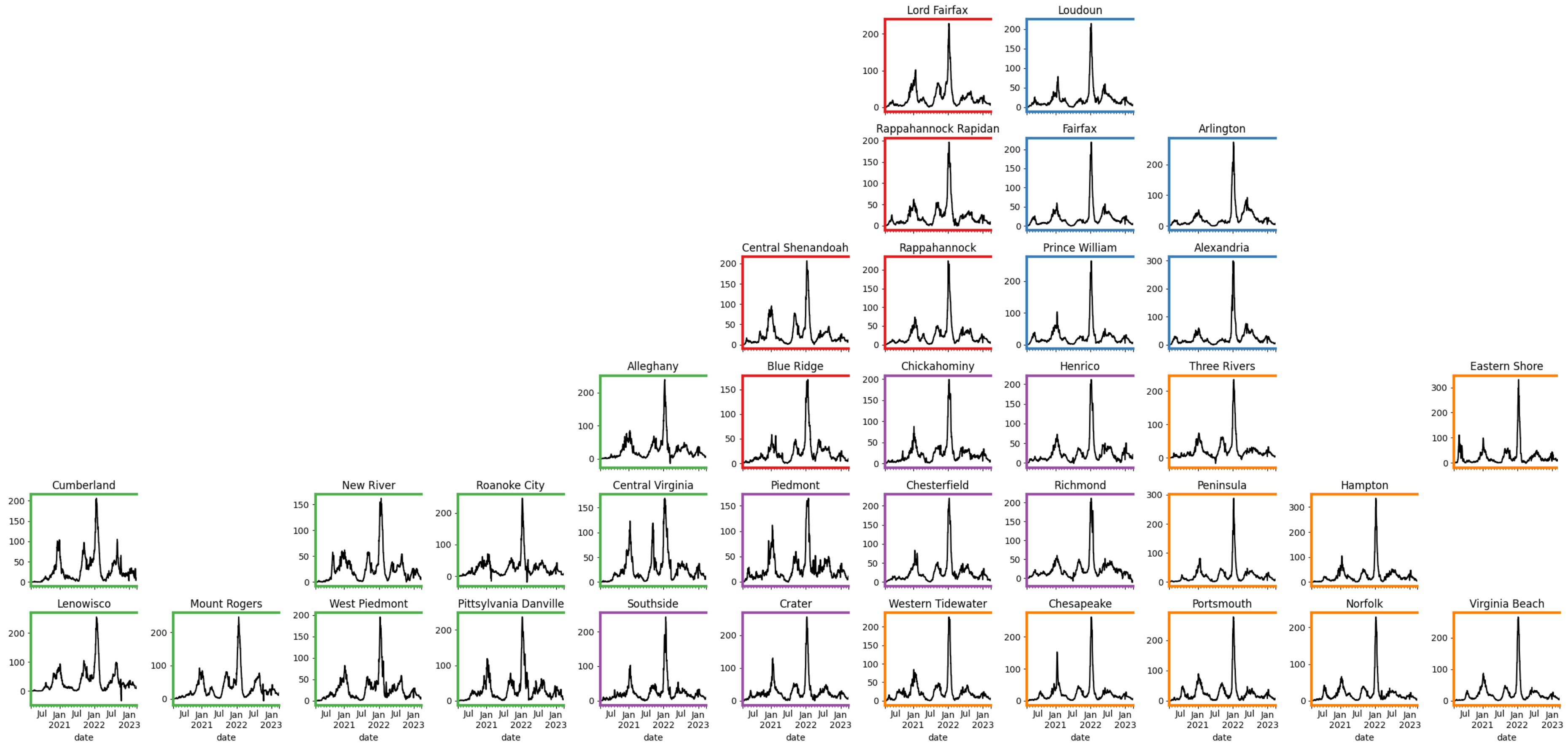
- Case rates and hospitalizations from COVID-19 continue decline but rate is slowing towards a plateau
  - Hospital occupancy down to levels last seen in early May of 2022
- Influenza hospitalizations remain very low and ILI activity remains below seasonal threshold

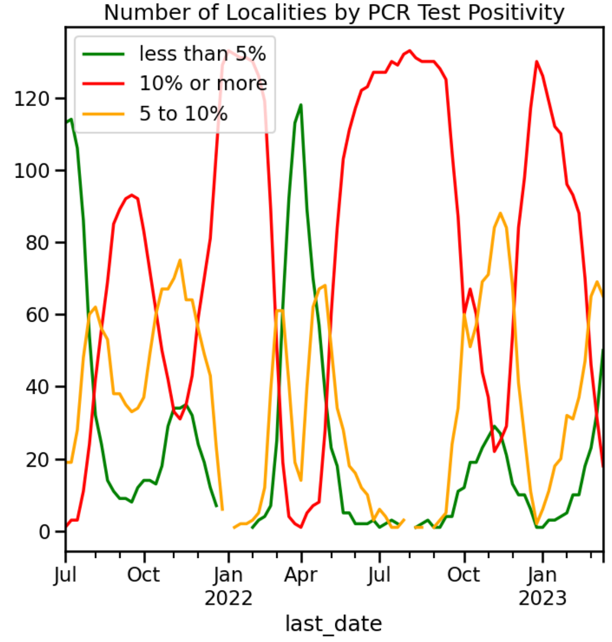
Model Updates

- Projected Trajectories from previous rounds remain on target, no new projections made this round

COVID-19 Surveillance

Case Rates (per 100k) and Test Positivity





County level RT-PCR test positivity

Green: <5.0% (or <20 tests in past 14 days)

Orange: 5.0%-10.0% (or <500 tests and <2000 tests/100k and >10% positivity over 14 days)

Red: >10.0% (and not "Green" or "Yellow")

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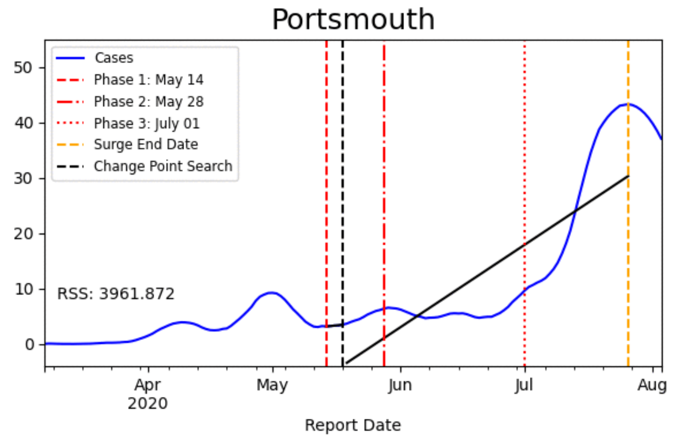
District Trajectories

Goal: Define epochs of a Health District's COVID-19 incidence to characterize the current trajectory

Method: Find recent peak and use hockey stick fit to find inflection point afterwards, then use this period's slope to define the trajectory

Hockey stick fit

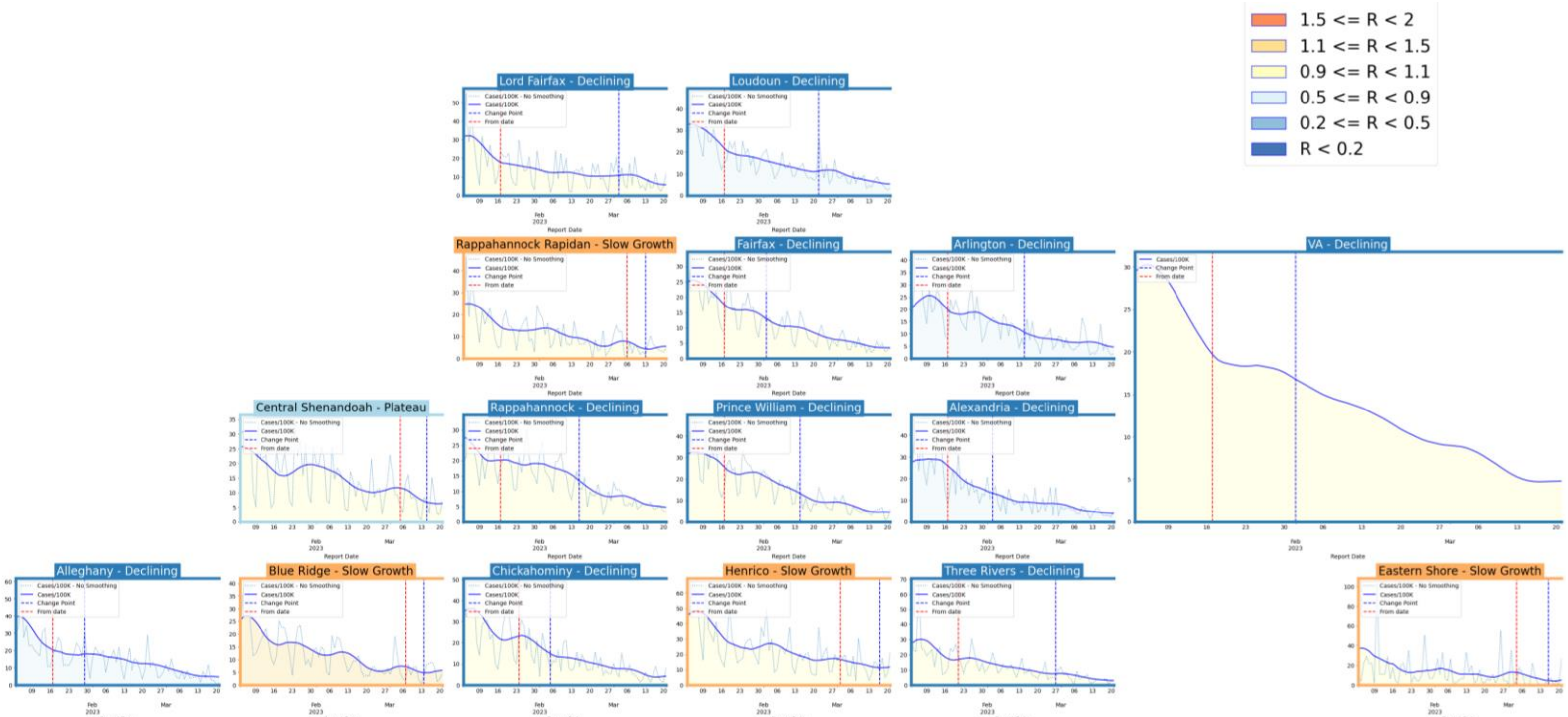


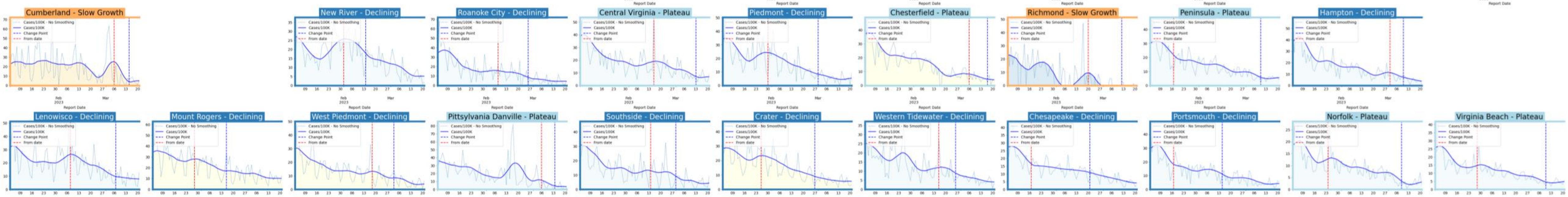
Trajectory	Description	Weekly Case Rate Slope (per 100k)	Weekly Hosp Rate Slope (per 100k)
Declining	Sustained decreases following a recent peak	slope < -0.88/day	slope < -0.07/day
Plateau	Steady level with minimal trend up or down	-0.88/day < slope < 0.42/day	-0.07/day < slope < 0.07/day
Slow Growth	Sustained growth not rapid enough to be considered a Surge	0.42/day < slope < 2.45/day	0.07/day < slope < 0.21/day
In Surge	Currently experiencing sustained rapid and significant growth	2.45/day < slope	0.21/day < slope

District Case Trajectories – last 10 weeks

Status	Number of Districts	
	Current Week	Last Week
Declining	22	(31)
Plateau	7	(4)
Slow Growth	6	(0)
In Surge	0	(0)

Curve shows smoothed case rate (per 100K)
Trajectories of states in label & chart box
Case Rate curve colored by Reproductive number





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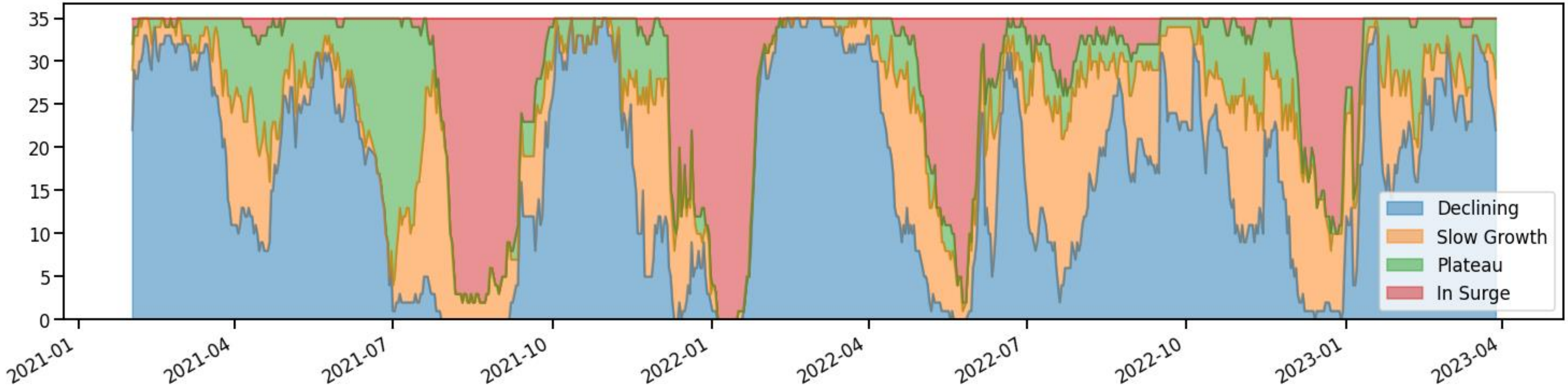
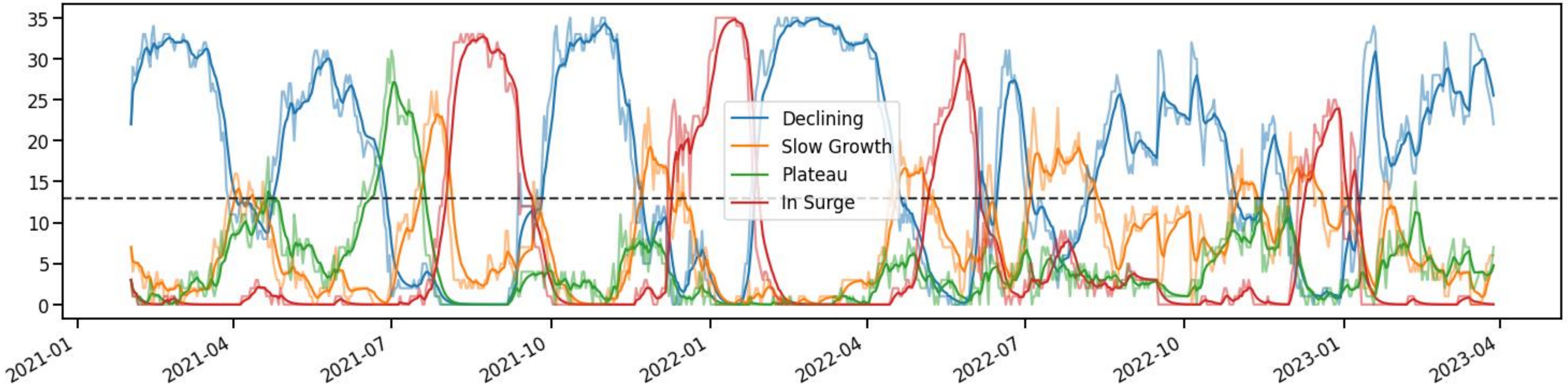
District Case Trajectories – Full History





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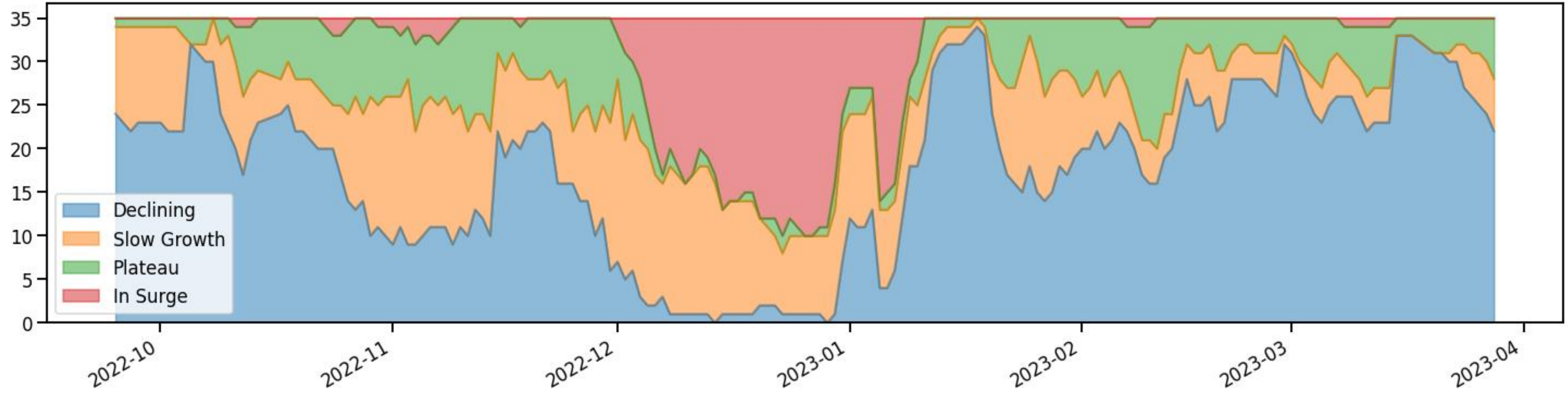
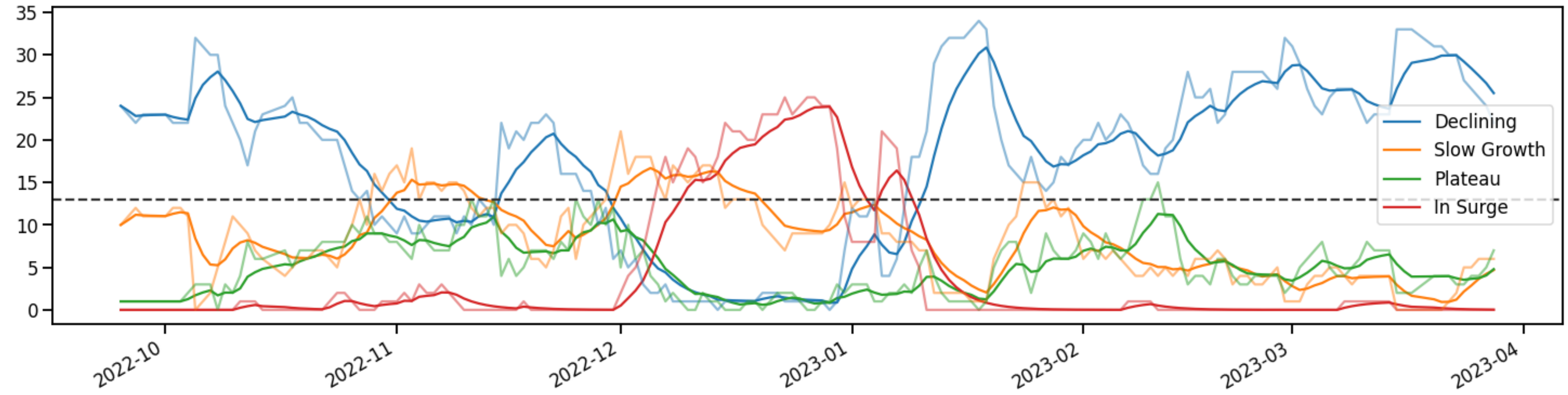
District Case Trajectories – Recent 6 months





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District Hospital Trajectories – last 10 weeks

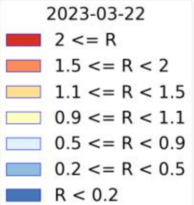
Status	Number of Districts	
	Current Week	Last Week
Declining	24	(29)
Plateau	10	(5)
Slow Growth	1	(1)
In Surge	0	(0)

Hospitalization by county is delayed, these data are current as of

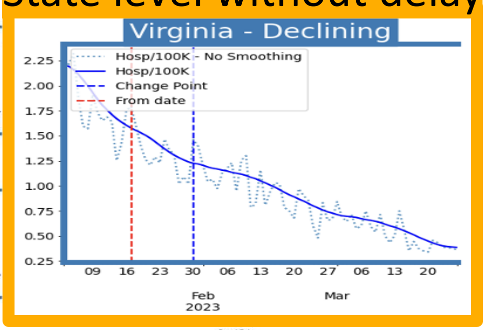
March 22nd

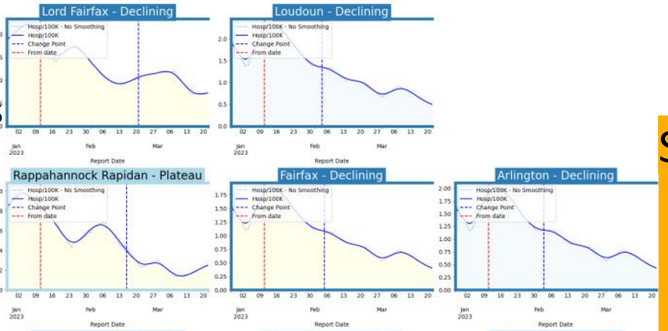
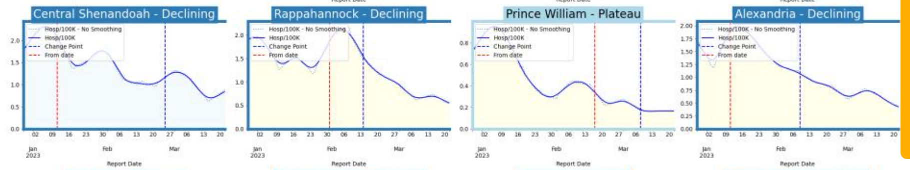
Curve shows smoothed hospitalization rate (per 100K) by district

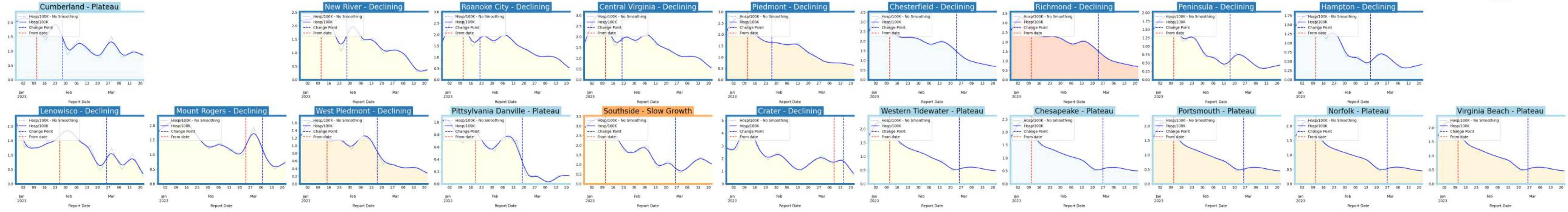
Hosp rate curve colored by R_e number



State level without delay





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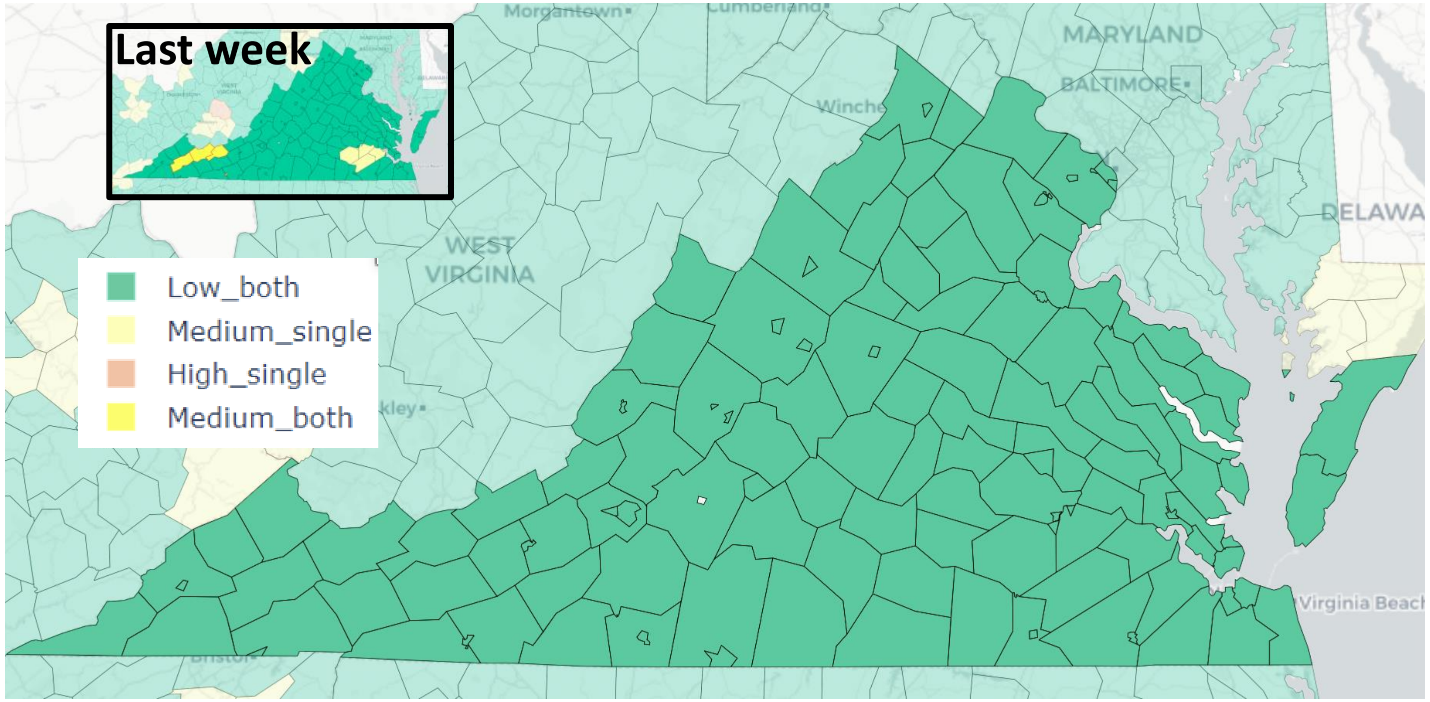
CDC's COVID-19 Community Levels



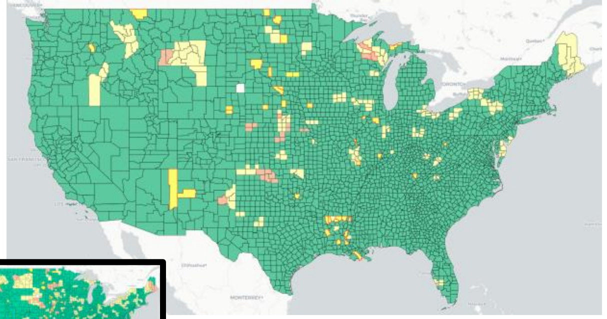
Red outline indicates county had 200 or more cases per 100k in last week

Pale color indicates either beds or occupancy set the level for this county

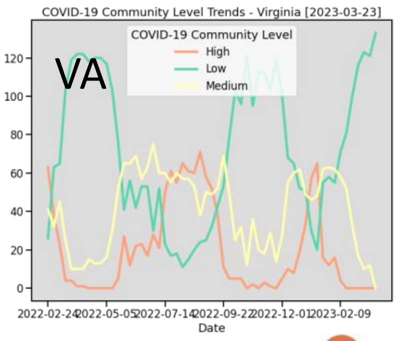
Dark color indicates both beds and occupancy set the level for this county

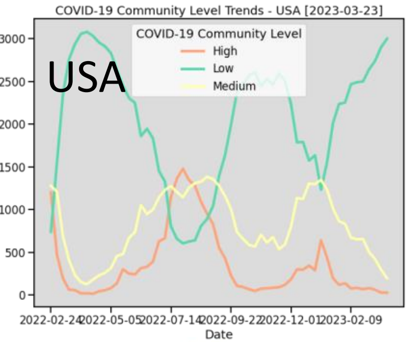
COVID-19 Community Levels – Use the Highest Level that Applies to Your Community				
New COVID-19 Cases Per 100,000 people in the past 7 days	Indicators	Low	Medium	High
Fewer than 200	New COVID-19 admissions per 100,000 population (7-day total)	<10.0	10.0-19.9	≥20.0
	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)	<10.0%	10.0-14.9%	≥15.0%
200 or more	New COVID-19 admissions per 100,000 population (7-day total)	NA	<10.0	≥10.0
	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)	NA	<10.0%	≥10.0%

The COVID-19 community level is determined by the higher of the new admissions and inpatient beds metrics, based on the current level of new cases per 100,000 population in the past 7 days



Last week





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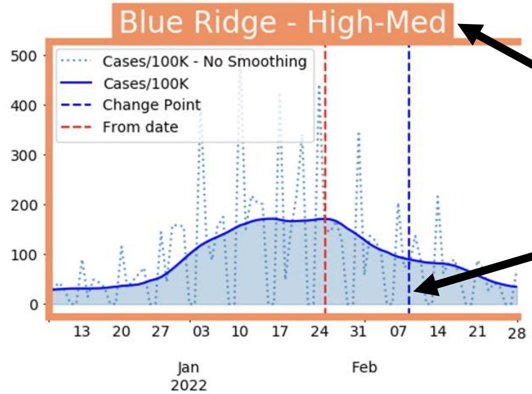
Data from: [CDC Data Tracker Portal]

District Trajectories with Community Levels

Community Level
(Title Color)
- High
- High-Med
- Med-High
- Medium
- Med-Low
- Low-Med
- Low

Curve shows smoothed case rate (per 100K)
CDC's new [Community Level] aggregated to district level in label & chart box color
Case Rate curve colored by Trajectory

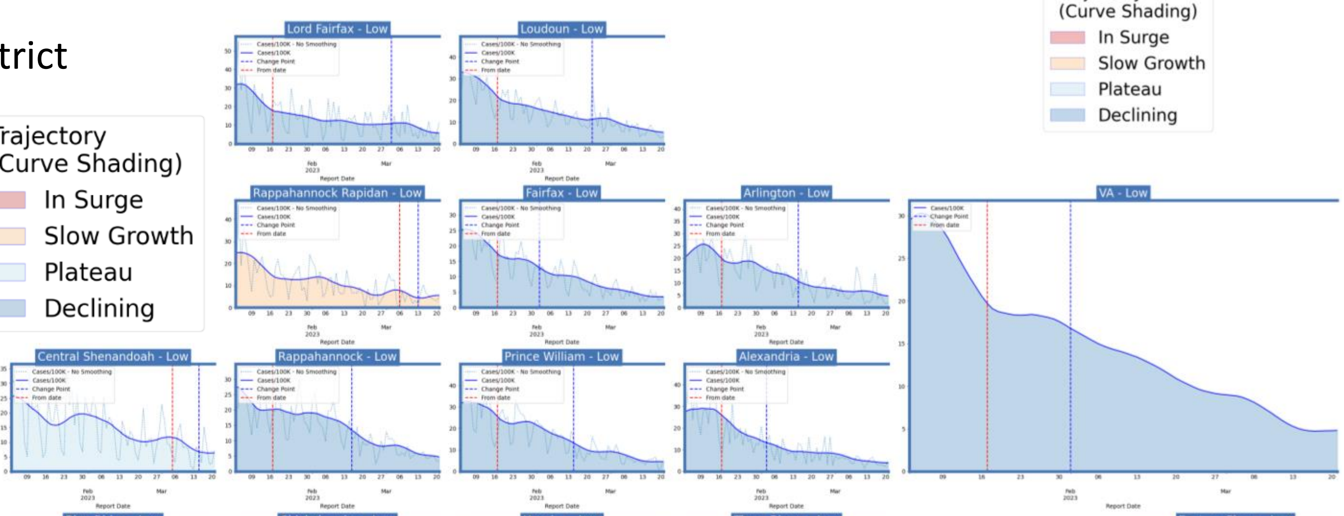


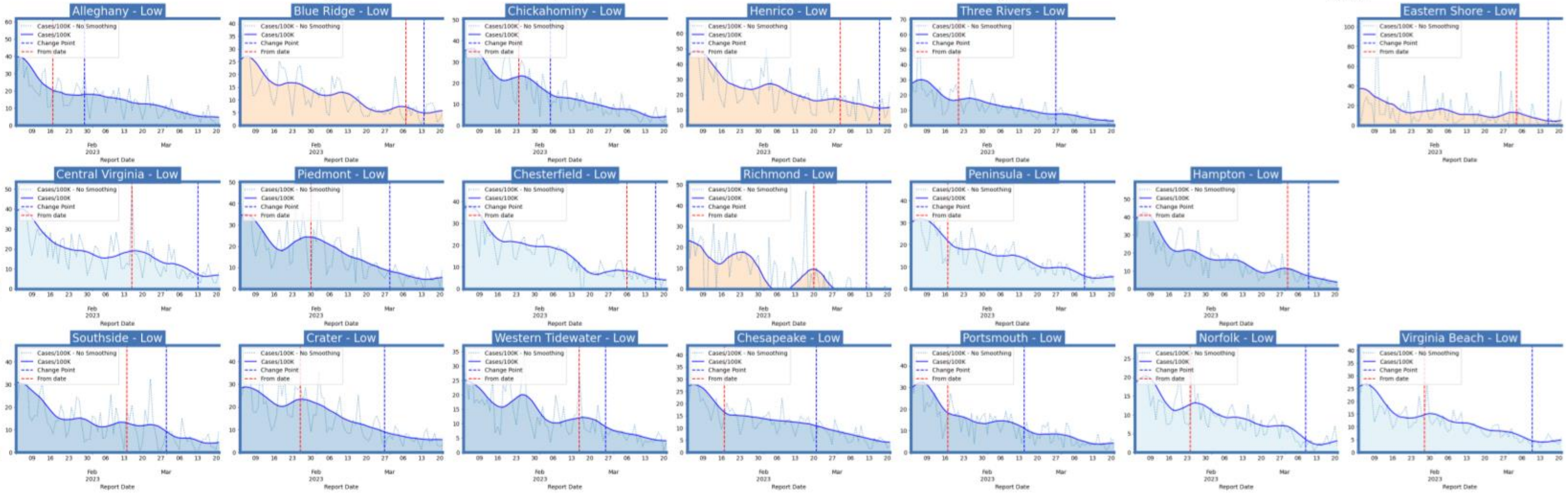
District's Aggregate Community Level

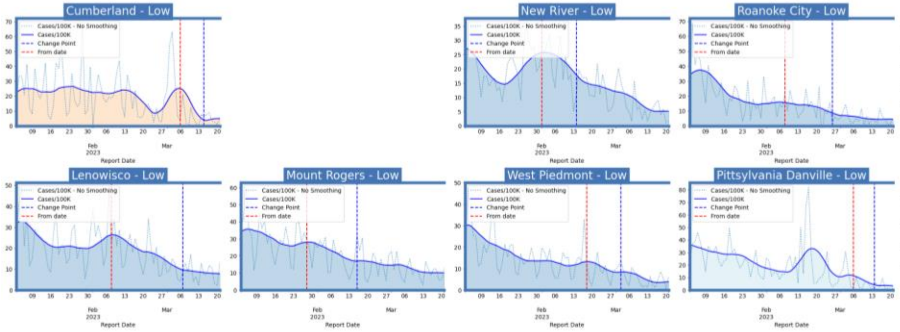
Aggregate level a simple mean of all levels for counties in district

Case rate Trajectory

Trajectory
(Curve Shading)
- In Surge
- Slow Growth
- Plateau
- Declining







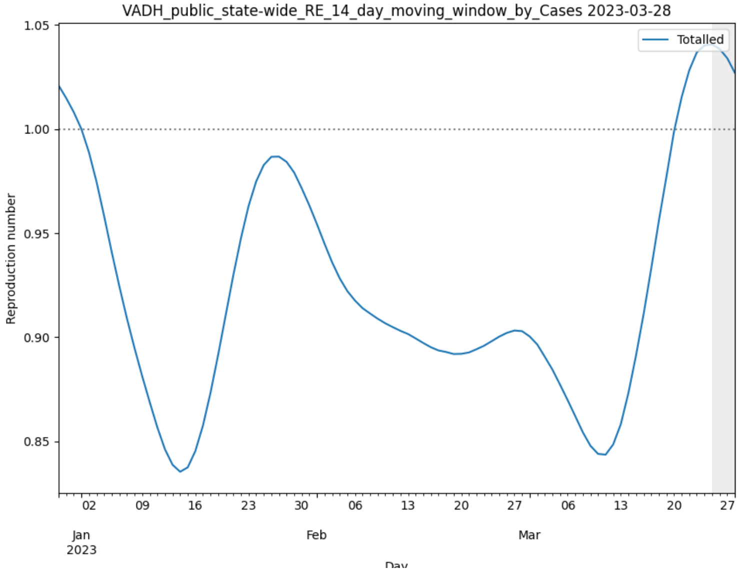
Trajectory
(Curve Shading)
- In Surge
- Slow Growth
- Plateau
- Declining

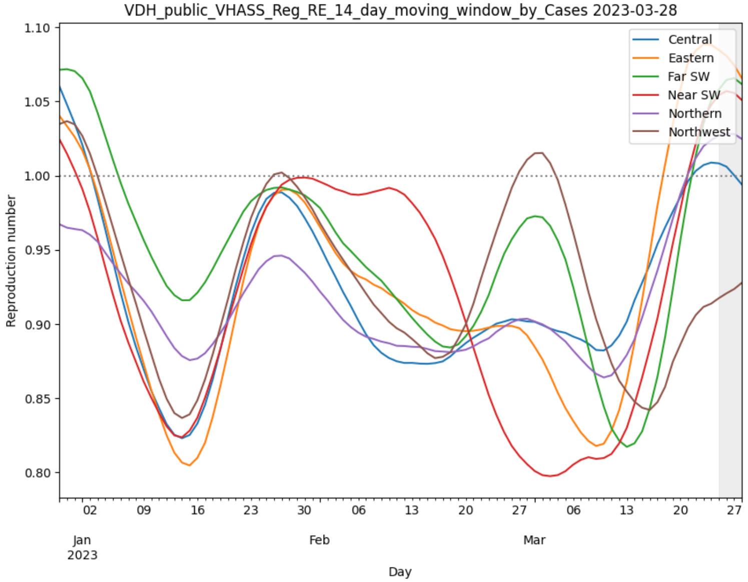
COVID-19 Growth Metrics

Estimating Daily Reproductive Number – VDH report dates

March 28th Estimates

Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	1.027	0.126
Central	0.994	0.078
Eastern	1.066	0.245
Far SW	1.062	0.017
Near SW	1.051	0.214
Northern	1.025	0.138
Northwest	0.928	-0.114





Methodology

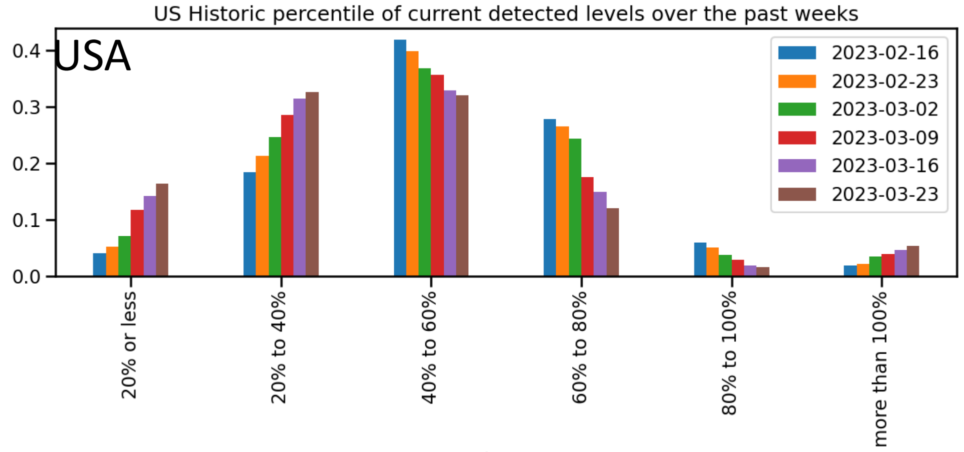
- Wallinga-Teunis method (EpiEstim[1]) for cases by **confirmation date**
- Serial interval: updated to discrete distribution from observations (mean=4.3, Flaxman et al, Nature 2020)
- Using Confirmation date since due to increasingly unstable estimates from onset date due to backfill

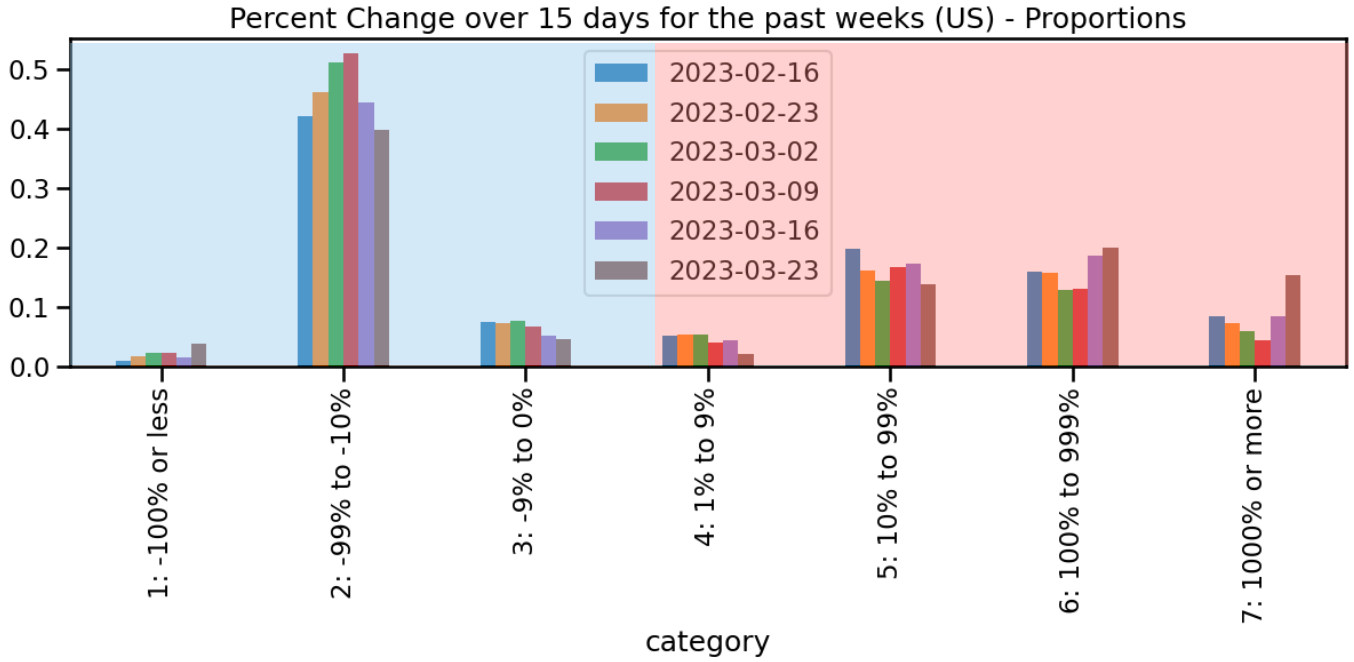
1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

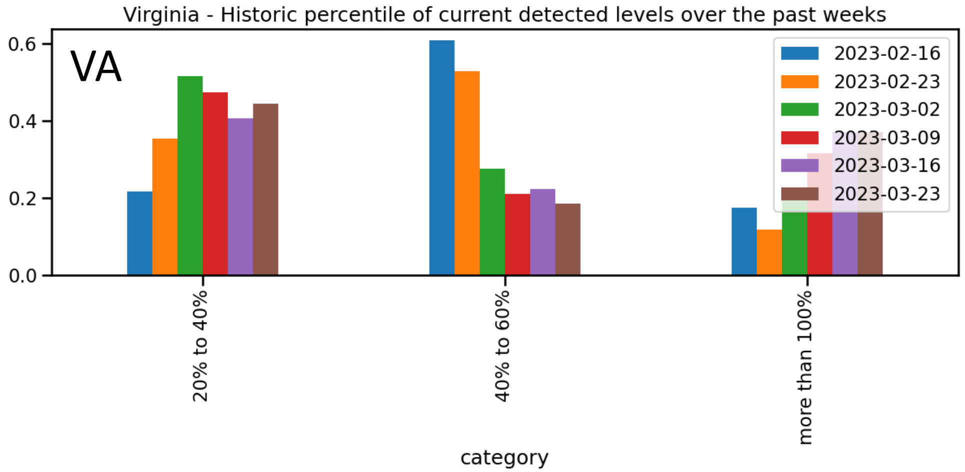
Wastewater Monitoring

Wastewater provides a coarse early warning of COVID-19 levels in communities

- Overall in the US, there is an increase in sites with increased levels of virus compared to 15 days ago
- Growth seen in the category where current virus levels are at or exceeding max of previous historical levels







Data Source: [CDC Data Tracker]

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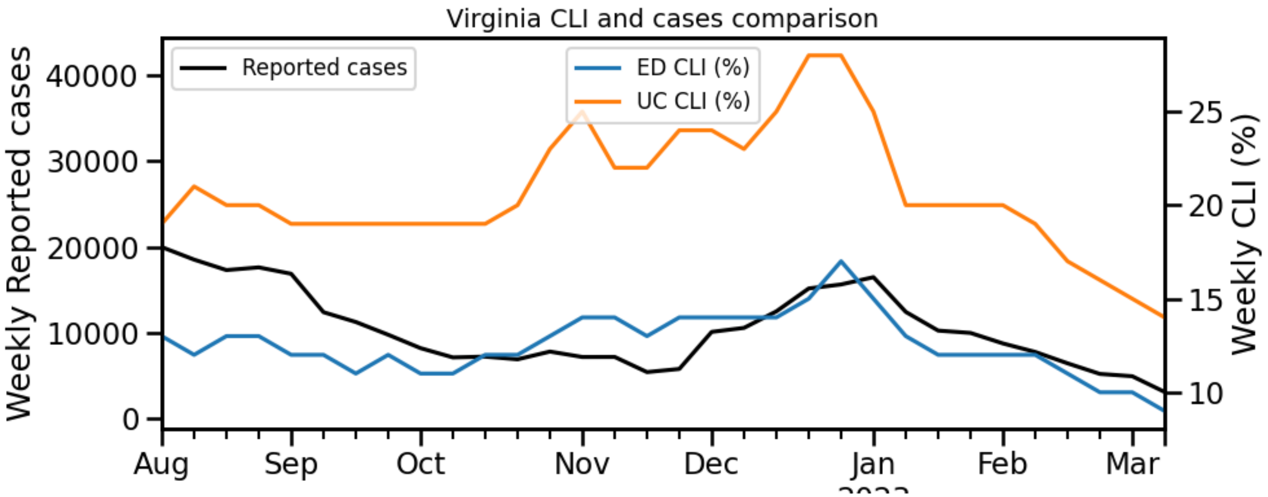
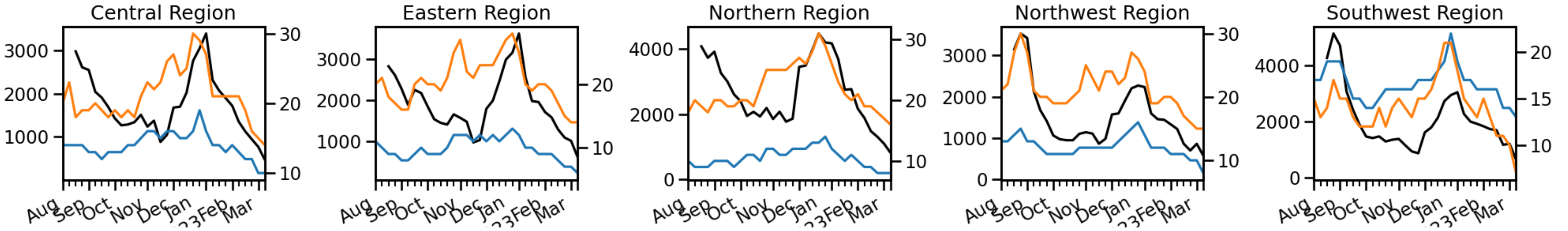
COVID-like Illness Activity

COVID-like Illness (CLI) gives a measure of COVID transmission in the community

- Emergency Dept (ED) based CLI is more correlated with case reporting
- Urgent Care (UC) is a leading indicator but may be influenced by testing for other URIs
- **Levels continue to decline into lowest levels in past 7 months**





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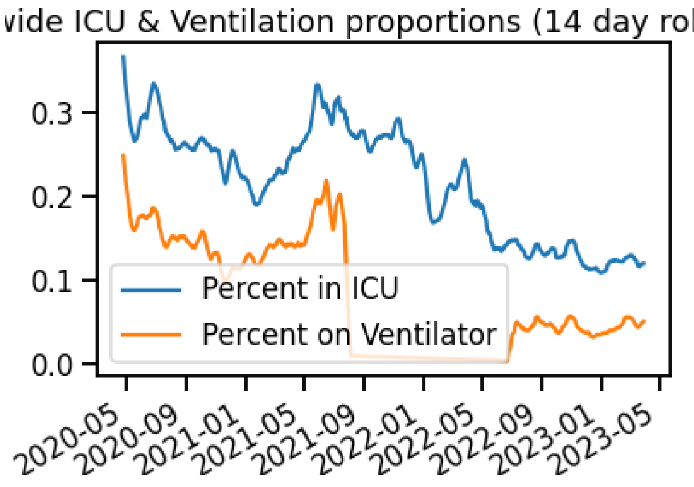
COVID-19 Severity Metrics

Hospitalizations and Severe Outcomes

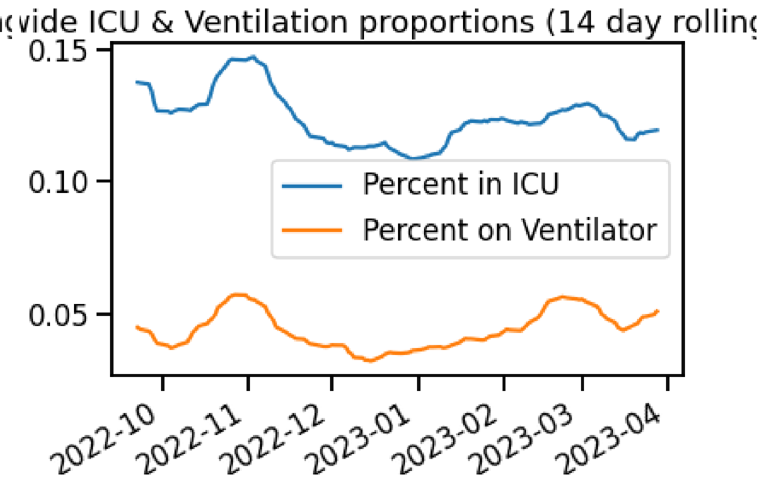
Proportion of most severe outcomes decreasing among those who are hospitalized

- ICU has declined from ~20% of hospitalized to 10-15% since initial Omicron wave
- Levels remain near all time lows, though have entered an oscillating plateau
- Regional trends are similar to state levels

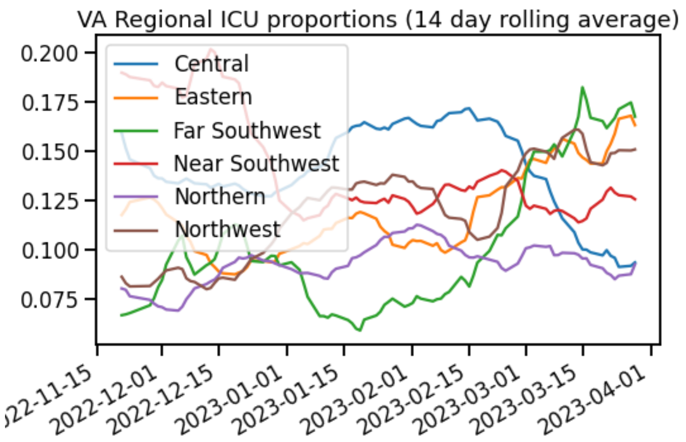
Virginia-wide – full pandemic



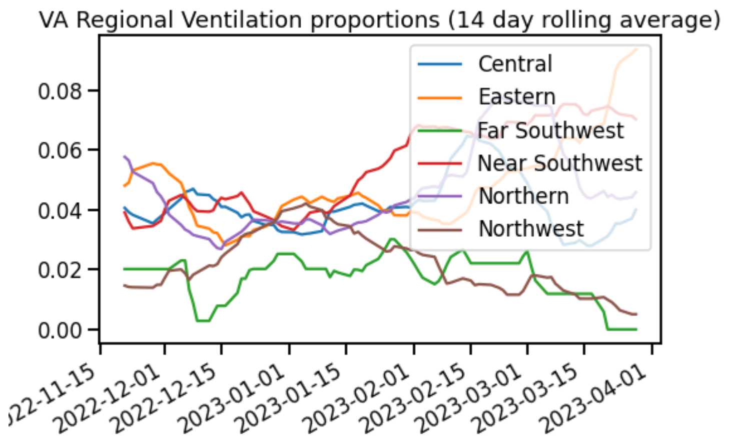
Virginia-wide – recent



Virginia Regional ICU percent



Virginia Regional Ventilation %



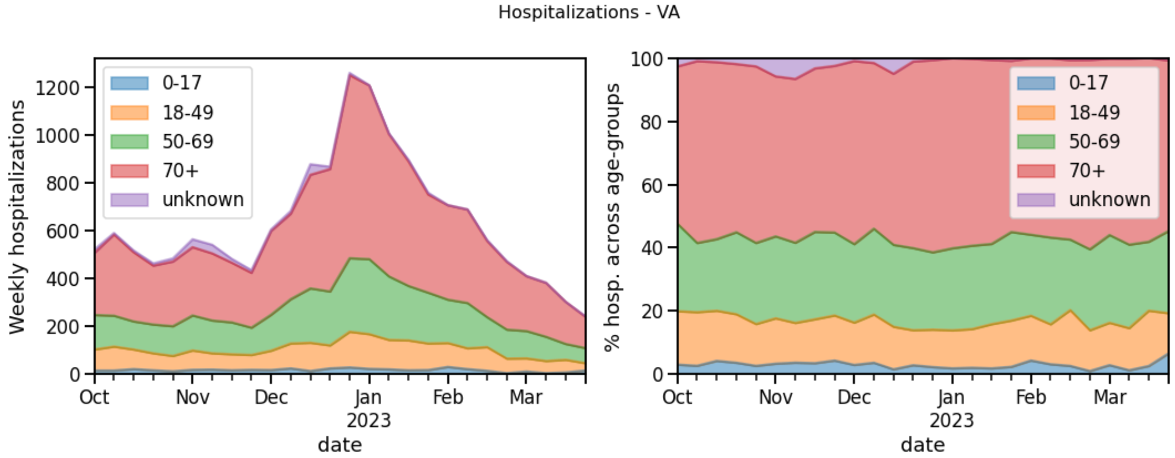
Hospitalizations in VA by Age

Age distribution in hospitals relatively stable

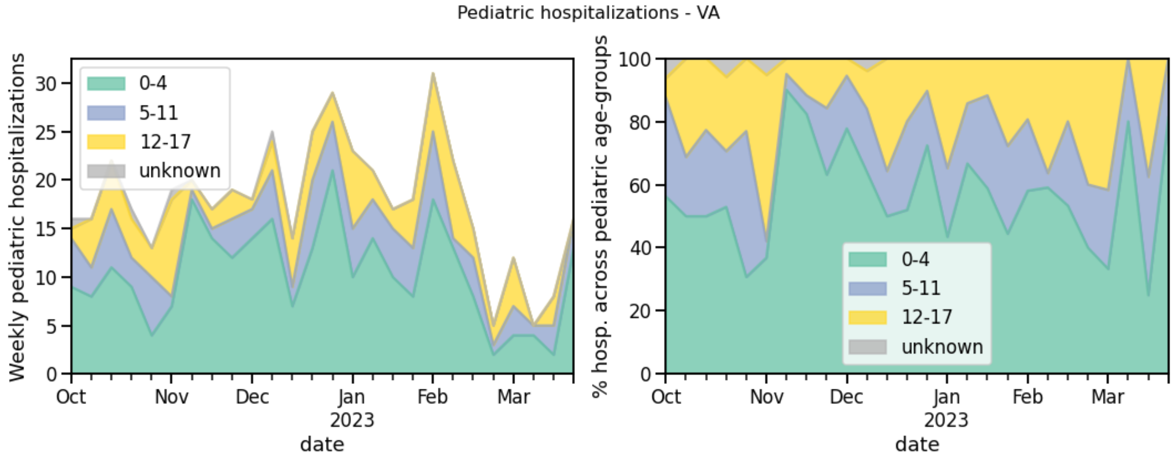
- Uptick in hospitalizations mostly fueled by 70+ age group
- Pediatric hospitalizations level off after uptick last week

Note: These data are lagged and based on HHS hospital reporting

Virginia Hospitalizations by Age (all ages)



Pediatric Hospitalizations by Age (0-17yo)



Data Source: Delphi and HHS

COVID-19 Spatial Epidemiology

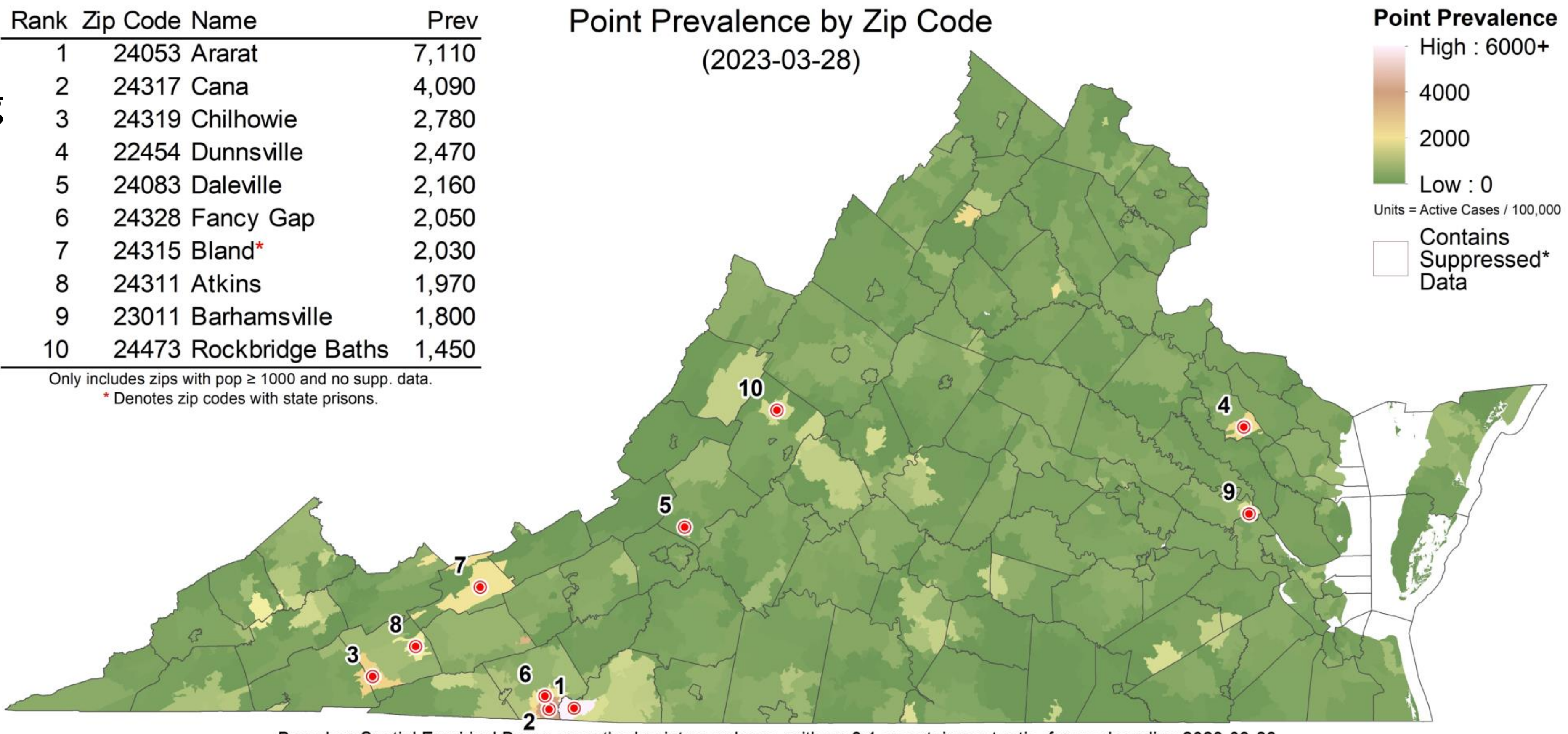
Zip code level weekly Case Rate (per 100K)

Case Rates in the last week by zip code

- Statewide prevalence has fallen to the lowest levels since the Summer of 2021. Though changing ascertainment rates may be confounding this data.
- Bland, VA is the only locale with a prison in this week’s top 10.
- A cluster of high values can be seen in Southwest VA near Galax.
- Some counts are low and suppressed to protect anonymity. They are shown with a red outline.

Rank	Zip Code	Name	Prev
1	24053	Ararat	7,110
2	24317	Cana	4,090
3	24319	Chilhowie	2,780
4	22454	Dunnsville	2,470
5	24083	Daleville	2,160
6	24328	Fancy Gap	2,050
7	24315	Bland*	2,030
8	24311	Atkins	1,970
9	23011	Barhamsville	1,800
10	24473	Rockbridge Baths	1,450

Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-03-28.

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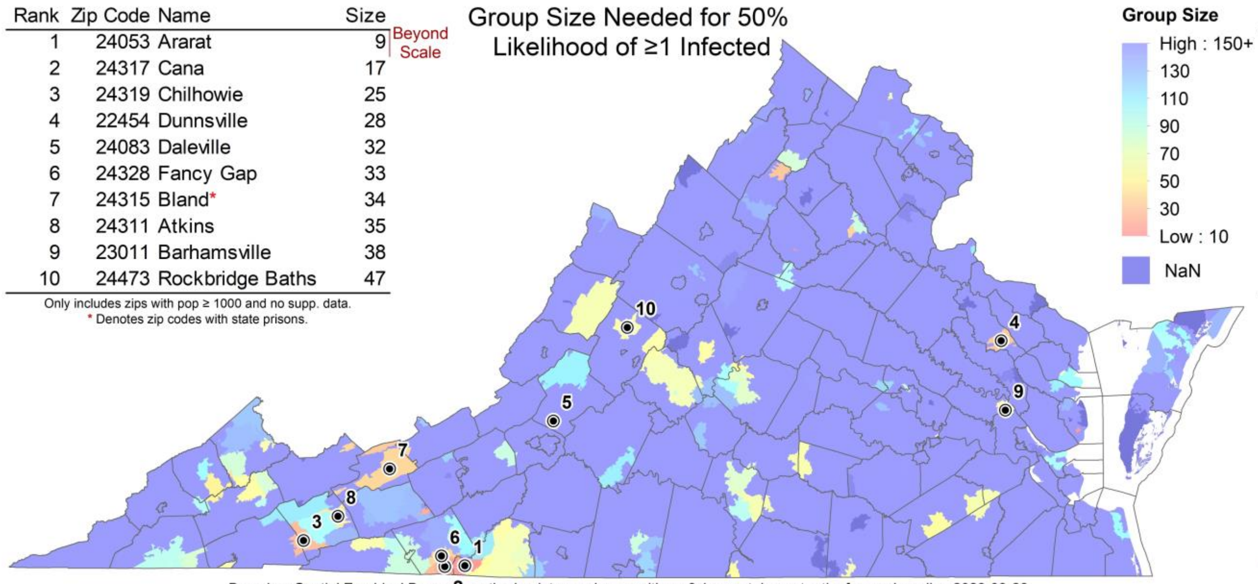
Risk of Exposure by Group Size and HCW prevalence

Case Prevalence in the last week by zip code used to calculate risk of encountering someone infected in a gathering of randomly selected people

- **Group Size**: Assumes **8 undetected infections** per confirmed case (ascertainment rate from recent seroprevalence survey) and shows minimum size of a group with a 50% chance an individual is infected by zip code (e.g., in a group of 9 in Ararat, there is a 50% chance someone will be infected).
- **HCW ratio**: Case rate among health care workers (HCW) in the last fortnight using patient facing health care workers as the numerator / population's case prevalence. Most highlighted counties have < 5 HCW cases.

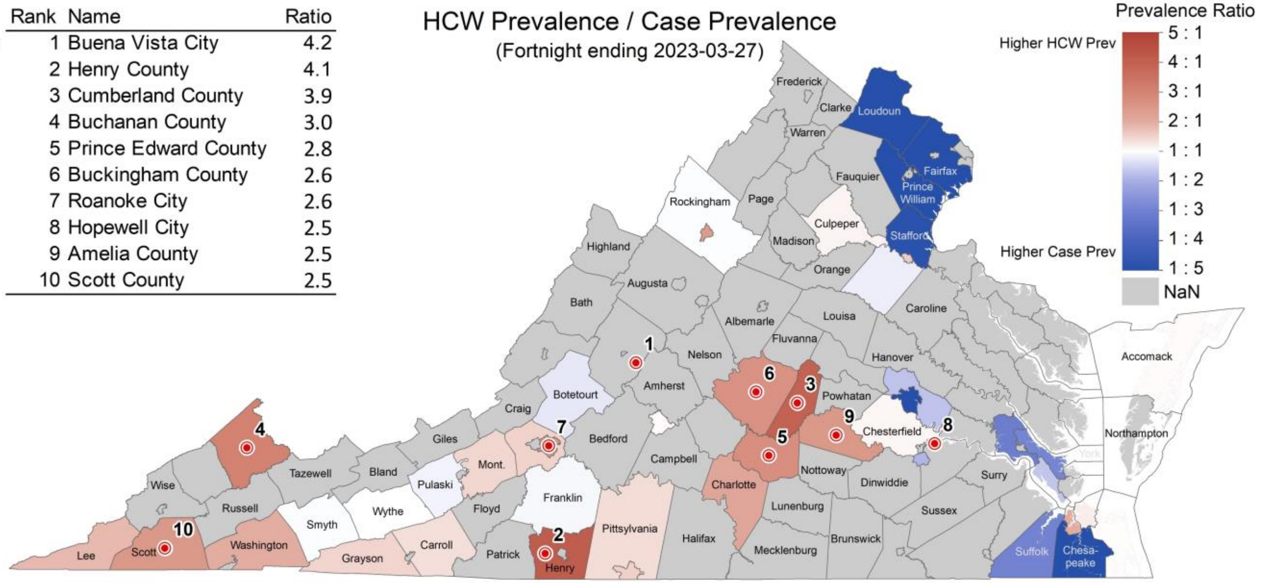
Rank	Zip Code	Name	Size
1	24053	Ararat	9 (Beyond Scale)
2	24317	Cana	17
3	24319	Chilhowie	25
4	22454	Dunnsville	28
5	24083	Daleville	32
6	24328	Fancy Gap	33
7	24315	Bland*	34
8	24311	Atkins	35
9	23011	Barhamsville	38
10	24473	Rockbridge Baths	47

Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-03-28.

Rank	Name	Ratio
1	Buena Vista City	4.2
2	Henry County	4.1
3	Cumberland County	3.9
4	Buchanan County	3.0
5	Prince Edward County	2.8
6	Buckingham County	2.6
7	Roanoke City	2.6
8	Hopewell City	2.5
9	Amelia County	2.5
10	Scott County	2.5



Note: This assumes that the ascertainment rate of healthcare workers is double that of the public.

Current Hot-Spots

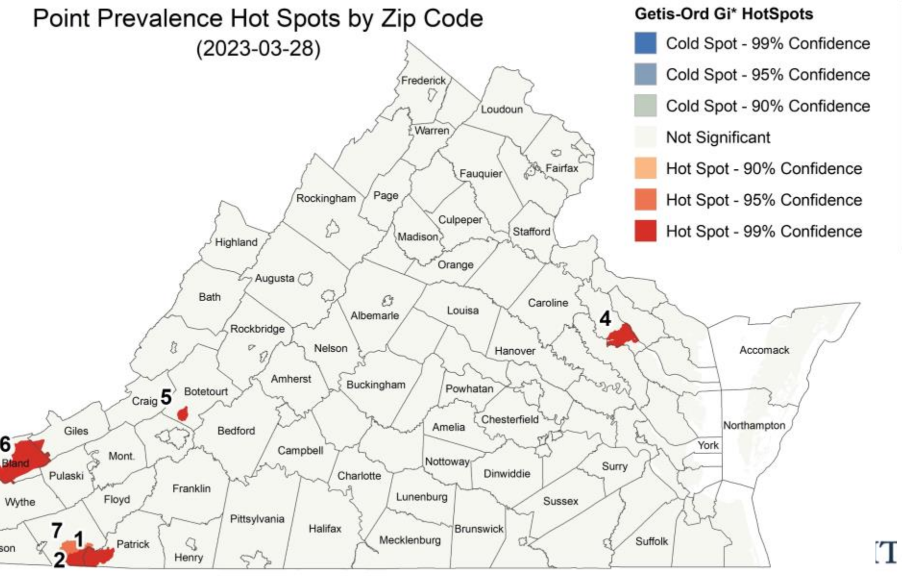
Case rates that are significantly different from neighboring areas or model projections

- **Spatial**: Getis-Ord Gi* based hot spots compare clusters of zip codes with weekly case prevalence higher than nearby zip codes to identify larger areas with statistically significant deviations
- **Temporal**: The weekly case rate (per 100K) projected last month compared to those observed by county, which highlights temporal fluctuations that differ from the model's projections.
- Most spatial hotspots this week were found in Southwest Virginia. Model slightly underpredicted parts of the far SW, and overpredicted cases in Southside. But models were within ± 50 per 100k for all health districts.

Spatial Hotspots

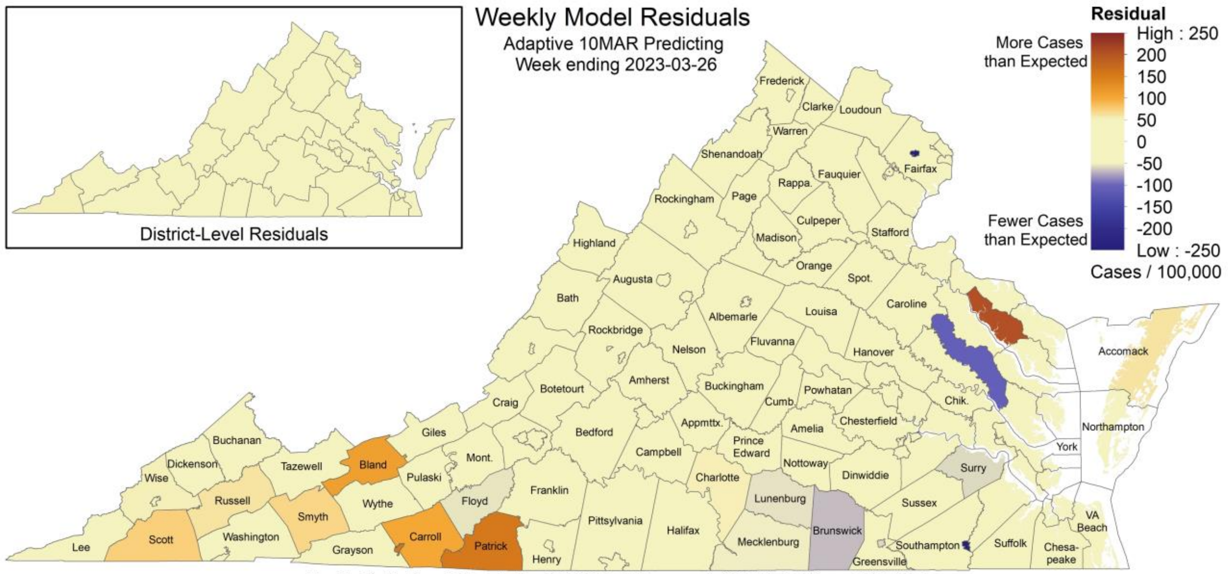
Spot	Zip Code	Name	Conf.
1	24053	Ararat	99%
2	24317	Cana	99%
3	24319	Chilhowie	99%
4	22454	Dunnsville	99%
5	24083	Daleville	99%
6	24315	Bland*	99%
7	24328	Fancy Gap	95%
8	24311	Atkins	95%

Only zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.



Based on Global Empirical Bayes smoothed point prevalence for week ending 2023-03-28.

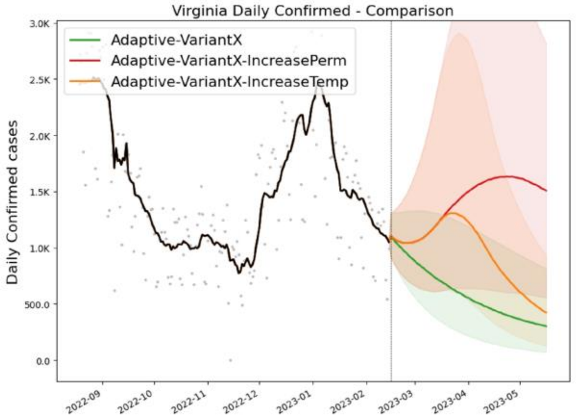
Clustered Temporal Hotspots

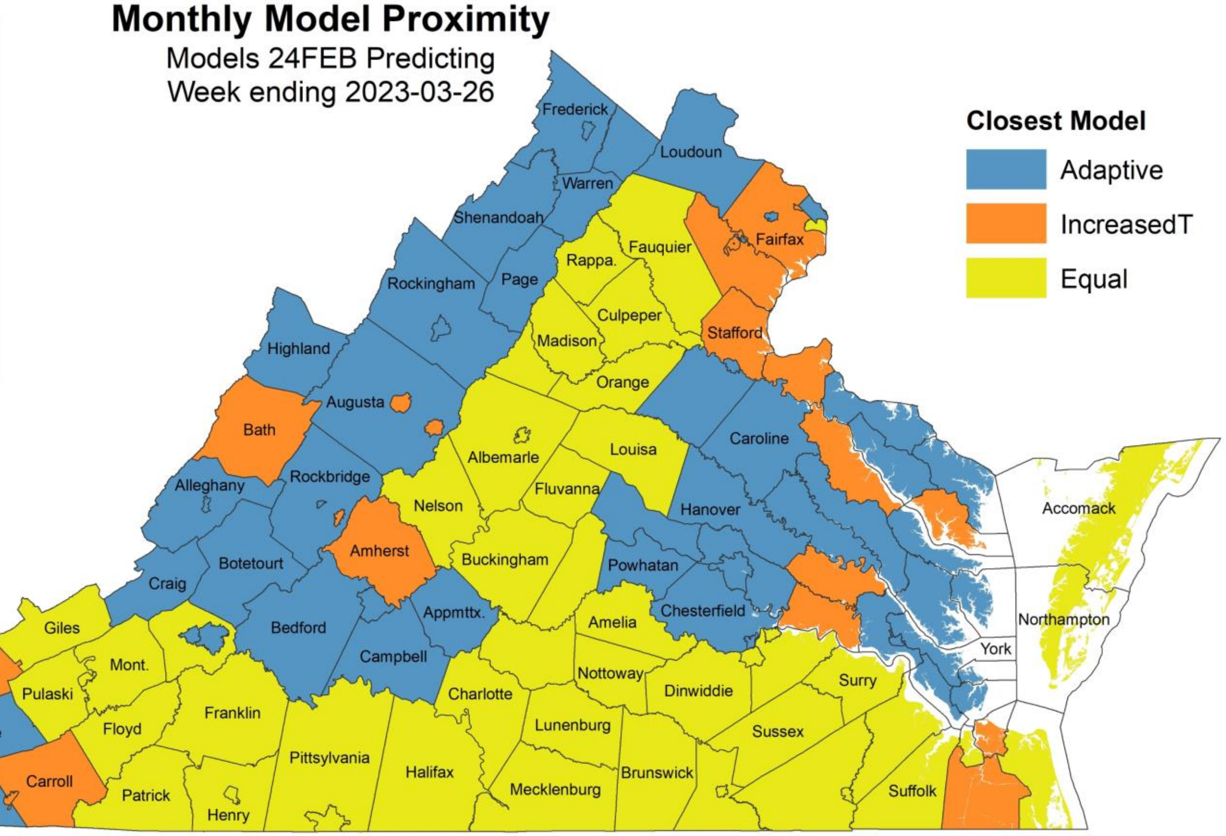


Health District Level Moran's I = -0.039326, Z-Score = -0.166241, P-Value = 0.867967
No Residual Autocorrelation Detected

Scenario Trajectory Tracking

Which scenario from a month ago did projection for each county track closest?

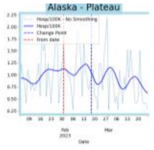




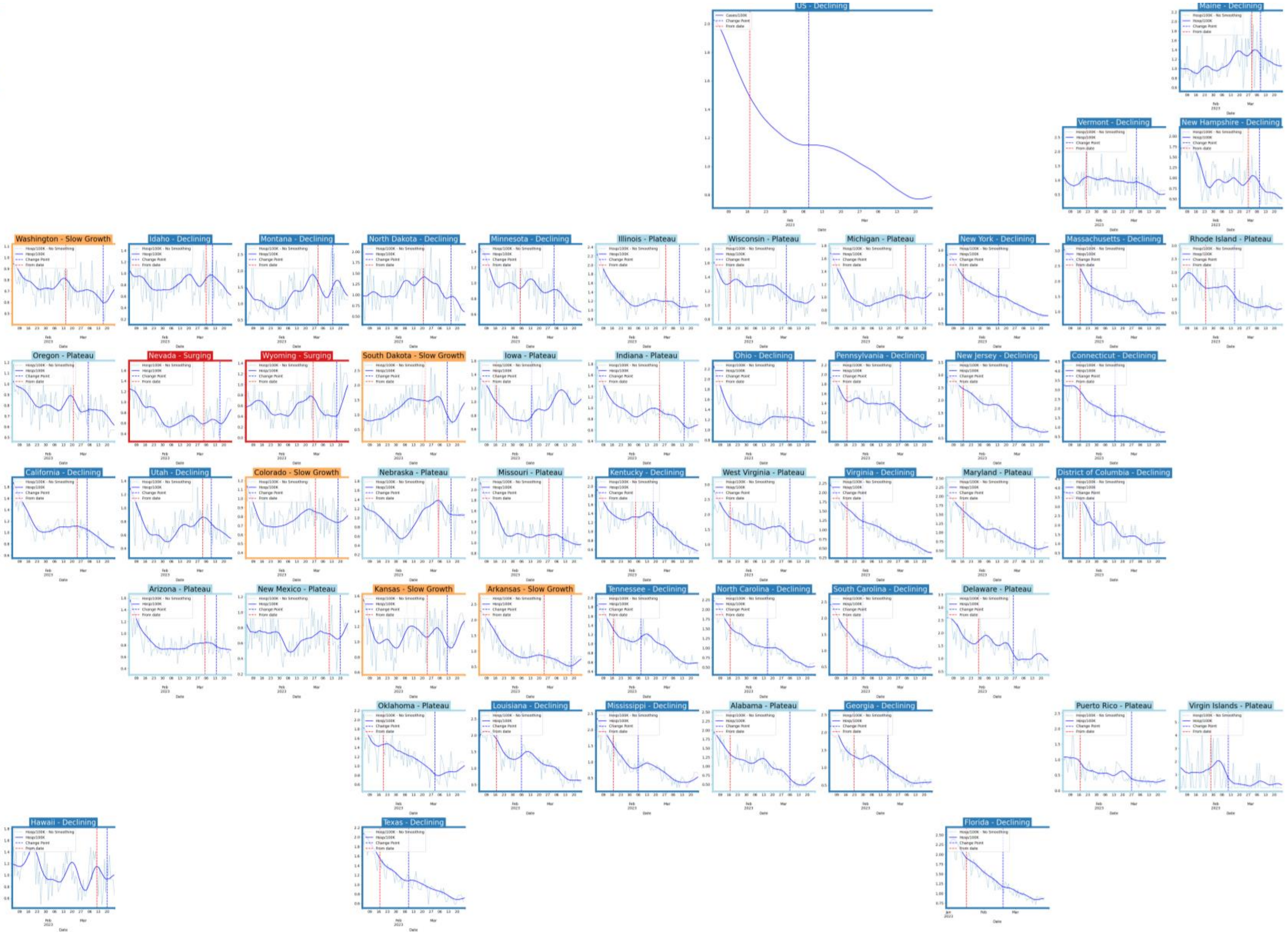
- One-month projections separate the scenarios more clearly and reveals larger overall patterns.
- The two “increased transmission” scenarios were identical at this time point and combined into a single color (shown in orange). This scenario fits only a handful of counties better than the current course model.

COVID-19 Broader Context

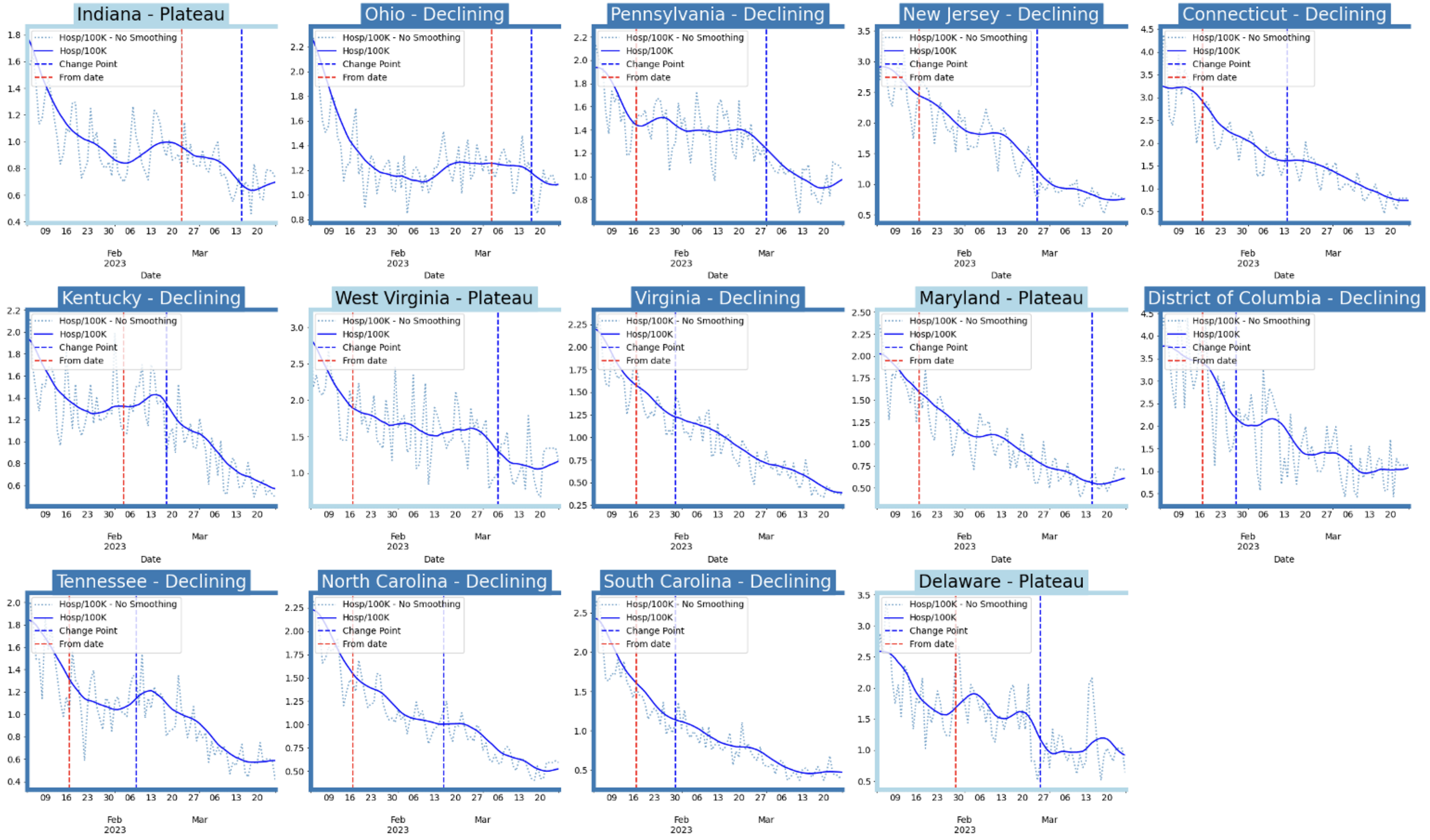
United States Hospitalizations



Status	Number of States	
	Current Week	Last Week
Declining	27	(30)
Plateau	19	(19)
Slow Growth	5	(3)
In Surge	2	(1)

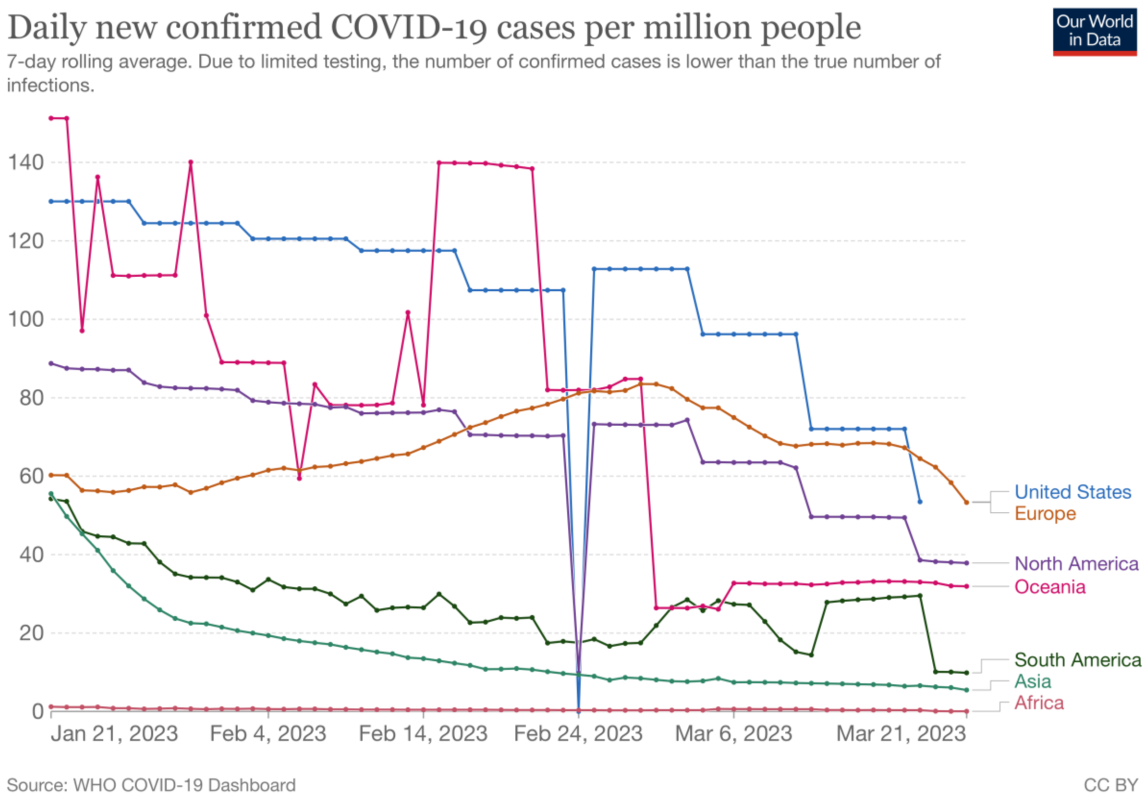


Virginia and Her Neighbors

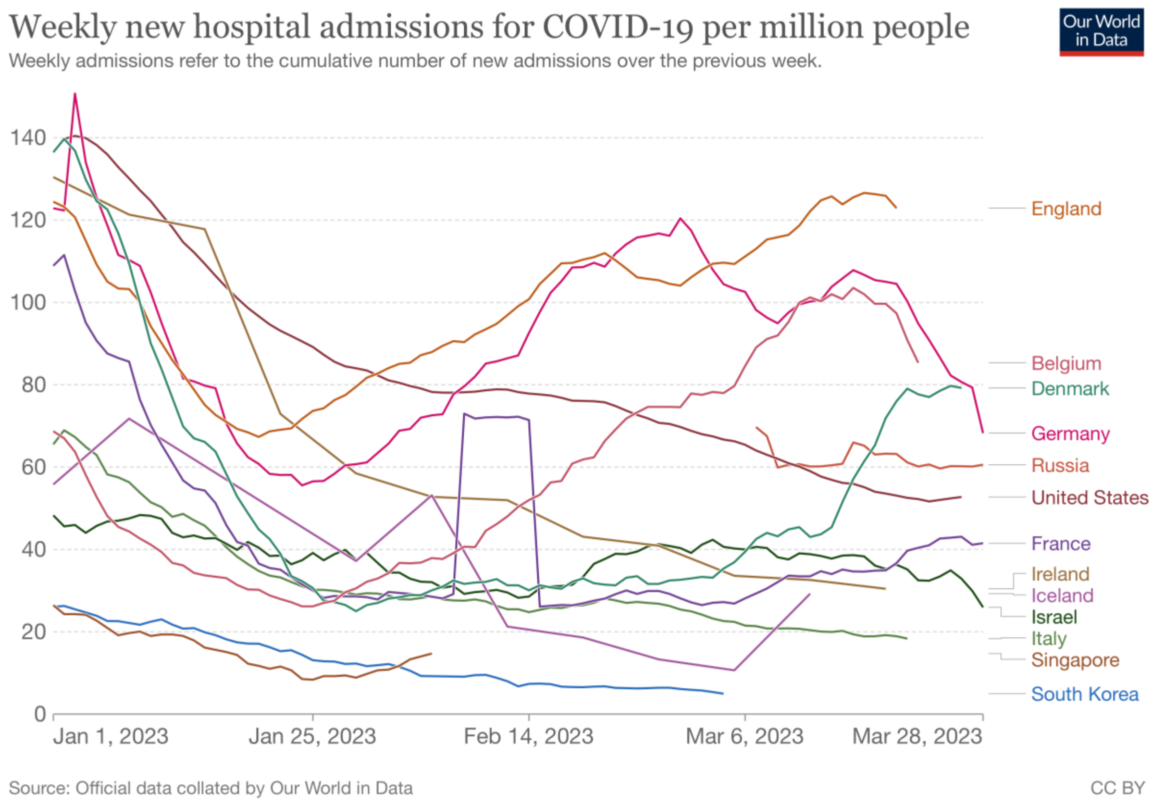


Around the World – Various trajectories

Confirmed cases



Hospitalizations



Our World in Data Our World in Data

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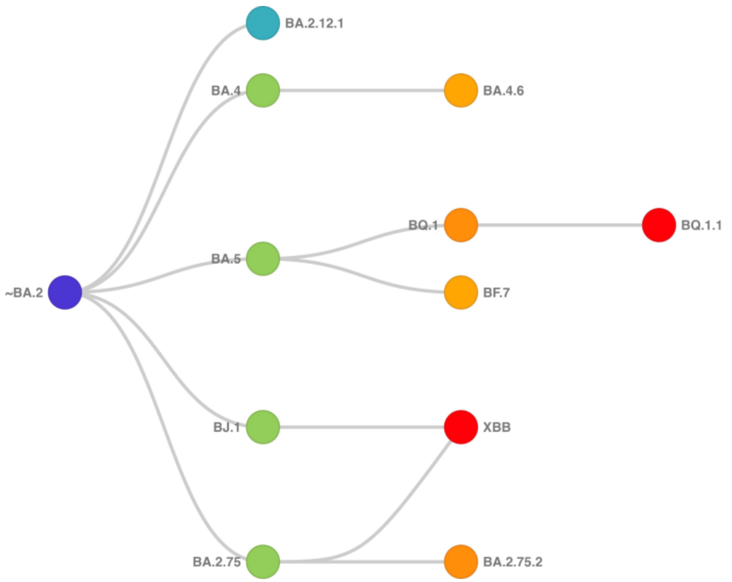
COVID-19 Genomic Update

SARS-CoV2 Variants of Concern

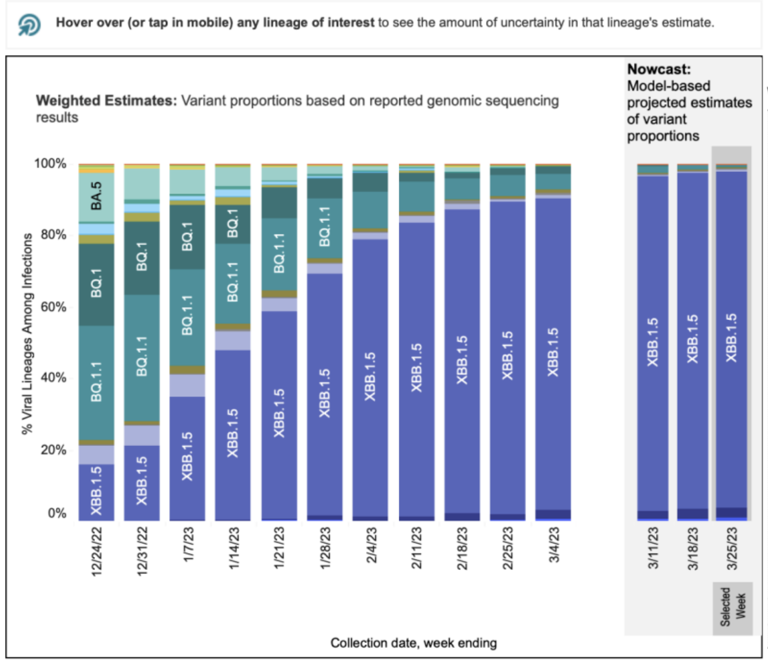
Emerging variants have potential to continue to alter the future trajectories of pandemic and have implications for future control

- **Variants have been observed to:** increase transmissibility, increase severity (more hospitalizations and/or deaths), and limit immunity provided by prior infection and vaccinations



https://clades.nextstrain.org

Weighted and Nowcast Estimates in HHS Region 3 for Weeks of 12/18/2022 – 3/25/2023



Nowcast Estimates in HHS Region 3 for 3/19/2023 – 3/25/2023

Region 3 - Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia

WHO label	Lineage #	US Class	%Total	95%PI
Omicron	XBB.1.5	VOC	94.1%	92.6-95.4%
	XBB.1.5.1	VOC	3.0%	1.9-4.6%
	XBB	VOC	0.9%	0.4-1.9%
	XBB.1.9.1	VOC	0.9%	0.5-1.5%
	BQ.1.1	VOC	0.7%	0.6-0.9%
	CH.1.1	VOC	0.2%	0.1-0.3%
	BQ.1	VOC	0.2%	0.1-0.2%
	BA.2	VOC	0.0%	0.0-0.1%
	BN.1	VOC	0.0%	0.0-0.0%
	BA.5	VOC	0.0%	0.0-0.0%
	BF.7	VOC	0.0%	0.0-0.0%
	BA.2.75	VOC	0.0%	0.0-0.0%
	BA.5.2.6	VOC	0.0%	0.0-0.0%
	BF.11	VOC	0.0%	0.0-0.0%
	BA.2.75.2	VOC	0.0%	0.0-0.0%
	B.1.1.529	VOC	0.0%	0.0-0.0%
	BA.1.1	VOC	0.0%	0.0-0.0%
	BA.4.6	VOC	0.0%	0.0-0.0%
	BA.4	VOC	0.0%	0.0-0.0%
Delta	B.1.617.2	VBM	0.0%	0.0-0.0%
Other	Other*		0.0%	0.0-0.0%

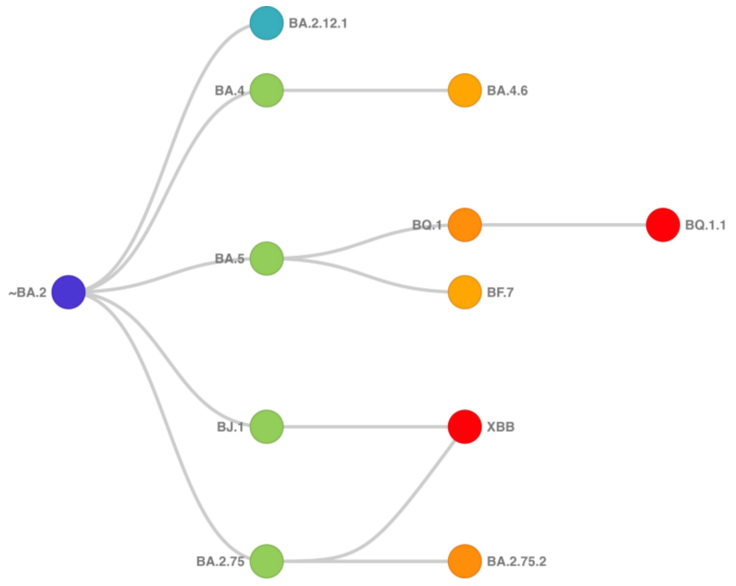
Omicron Updates*

- XBB.1.5 continues to dominate accounting for 94%
- XBB.1.5.1 is at 3%, and XBB.1.9.1 is nearly at 1%
- All other XBB strains (including XBB.1.16.1) is at 1%
- BQ.1.1, CH.1.1, and BQ.1 are all below 1% but remain in the population

*percentages are CDC NowCast Estimates

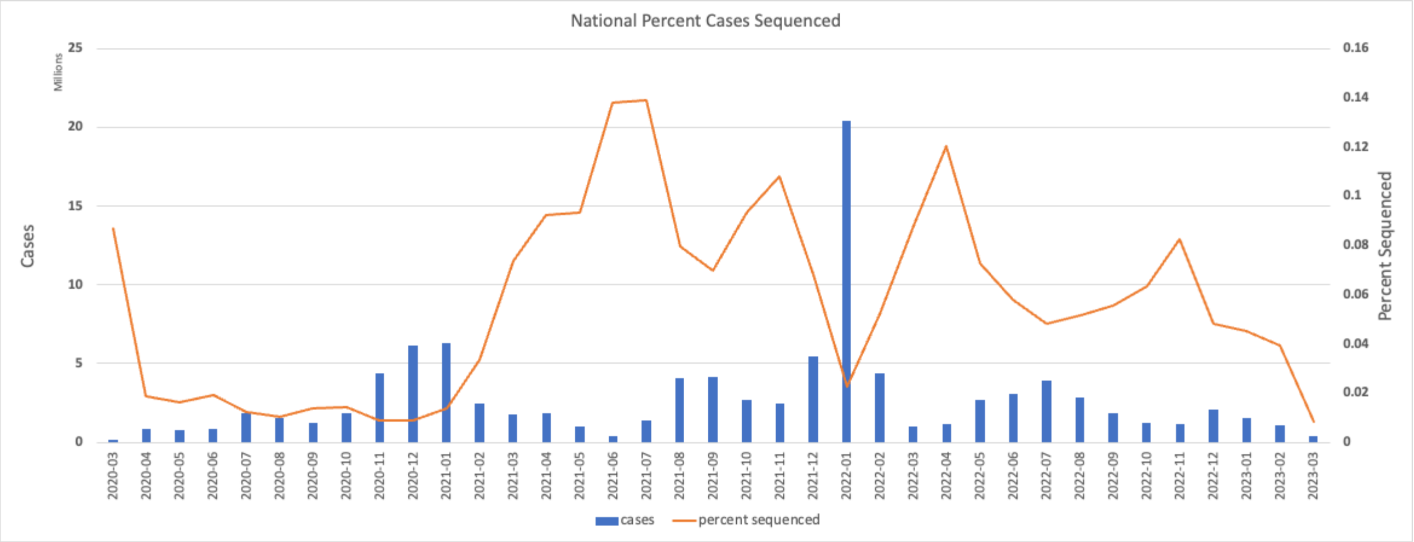
CDC Variant Tracking

SARS-CoV2 Sequencing



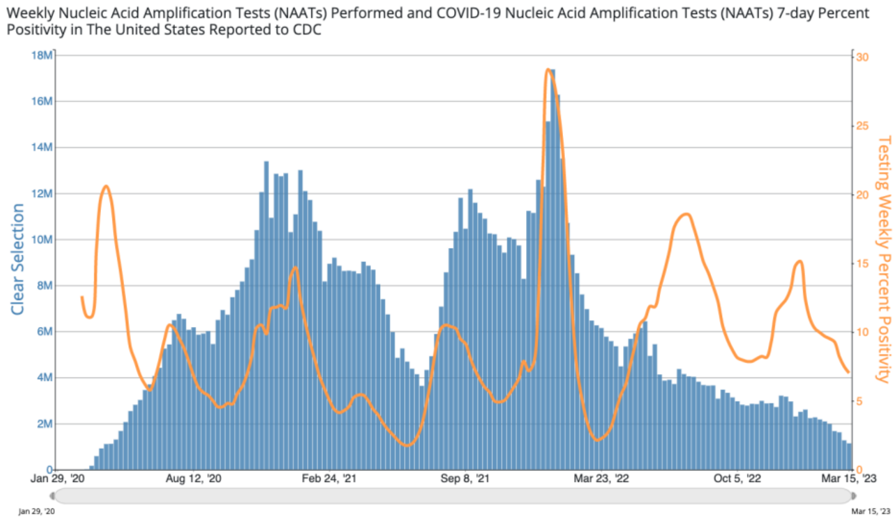
Emerging variants have potential to continue to alter the future trajectories of pandemic and have implications for future control

- Current proportion of cases being sequenced is on a downward trend nationally.
- Leveraging additional resources such as wastewater sequencing and adopting into existing infrastructure will be an important supplement



https://clades.nextstrain.org

United States



https://cov-spectrum.org/explore/United%20States/AllSamples/Past6M/sequencing-coverage

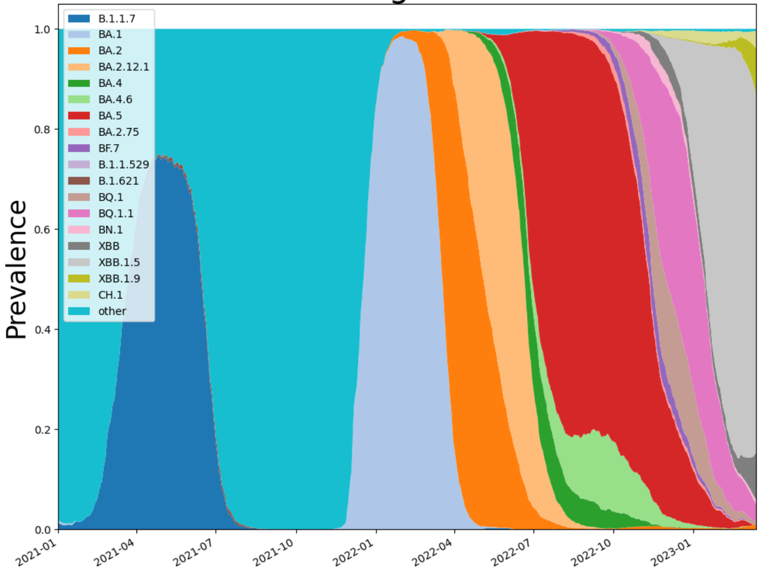
https://covid.cdc.gov/covid-data-tracker/#trends_7daytestresultsreported_7daytestingpositive_00

SARS-CoV2 Omicron Sub-Variants

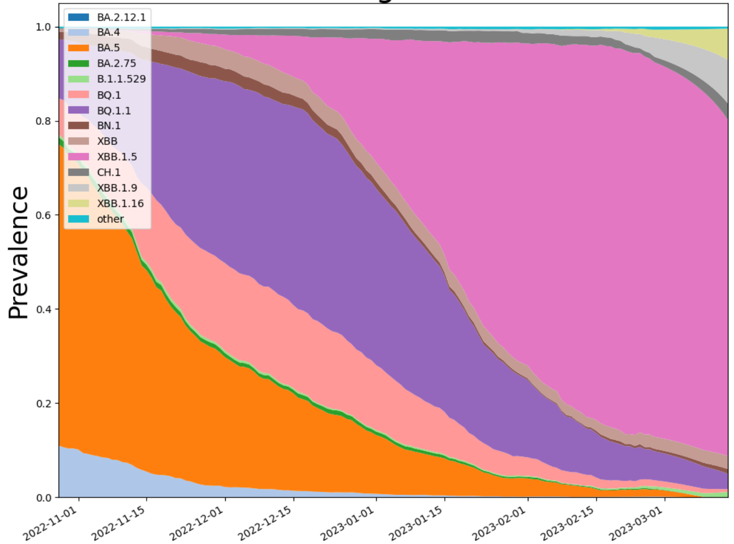
covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

Virginia

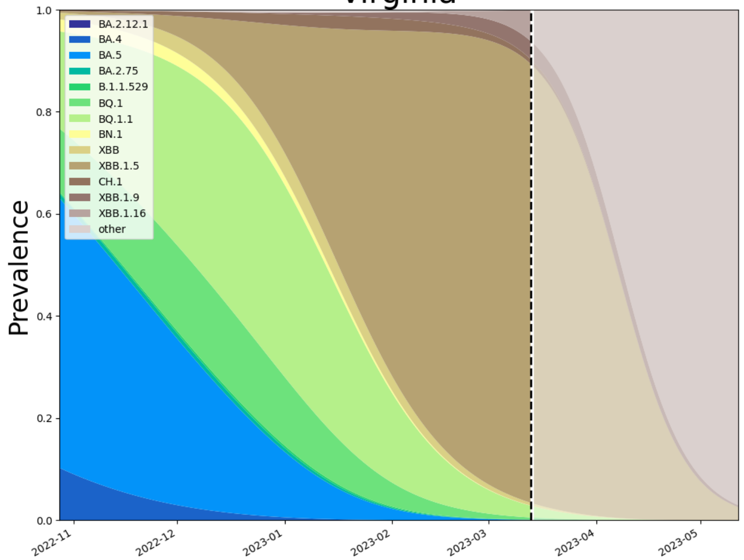


Virginia

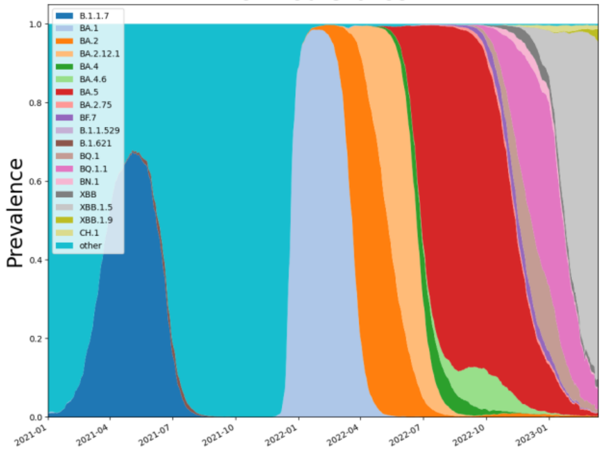


VoC Polynomial Fit Projections

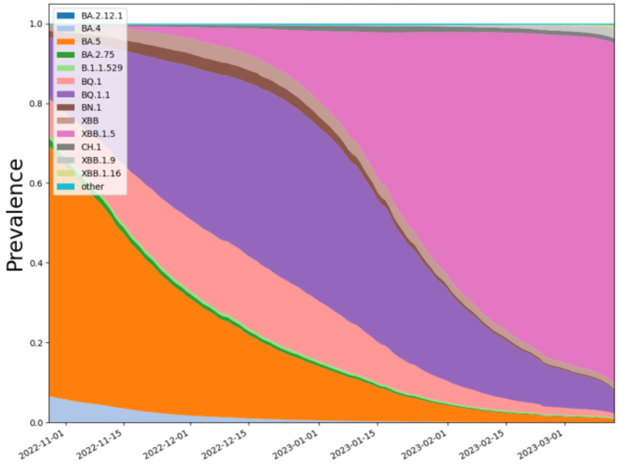
Virginia



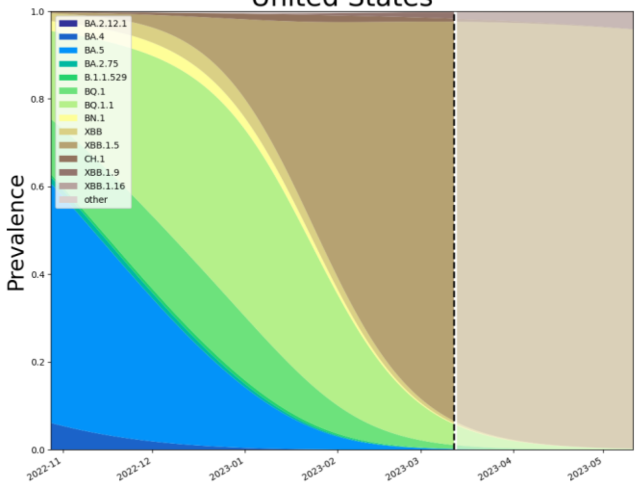
United States



United States



United States



Note:
Everything from dotted line forward is a projection.

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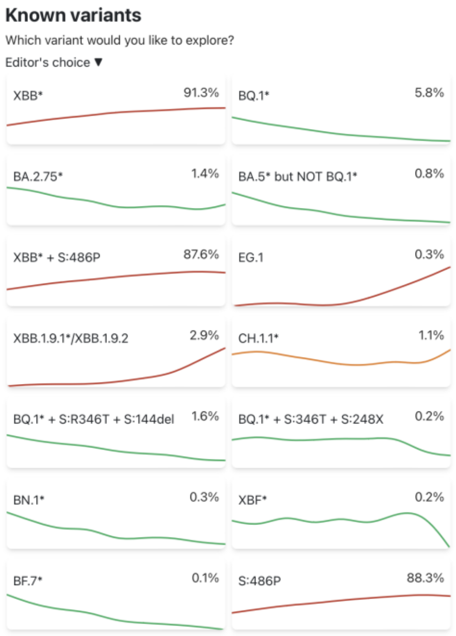
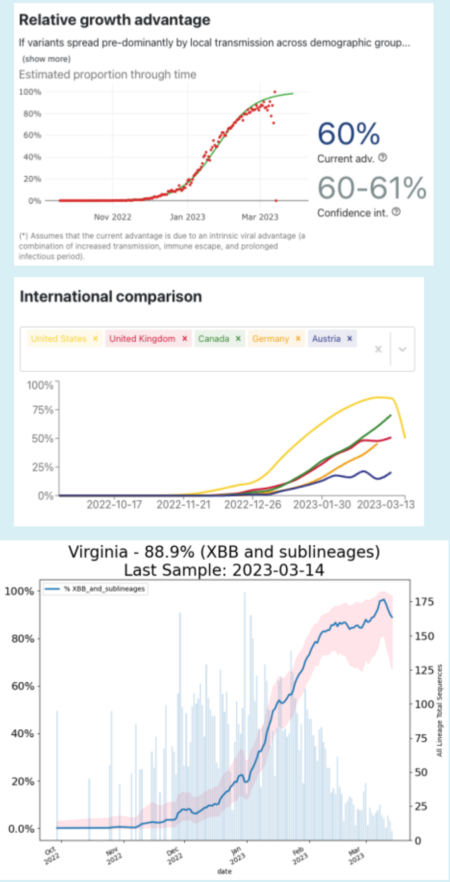
SARS-CoV2 Omicron Sub-Variants

COV-spectrum
“Editor’s choice”
Variants to watch

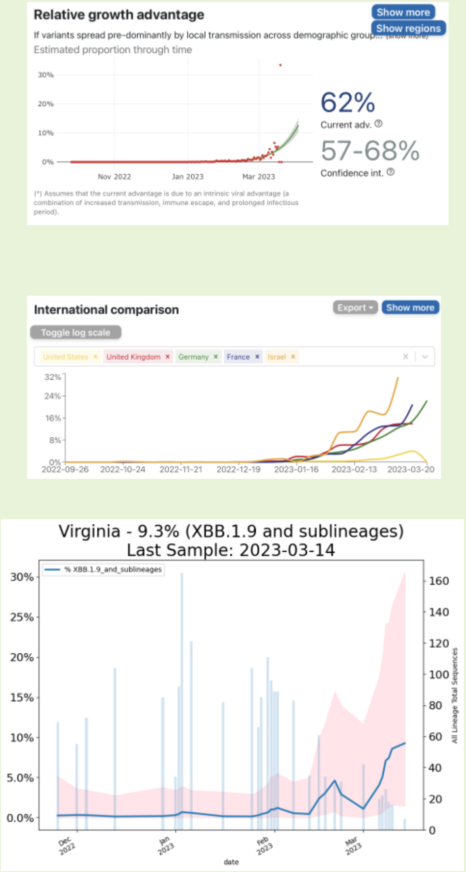


covSPECTRUM
Enabled by data from GISAID

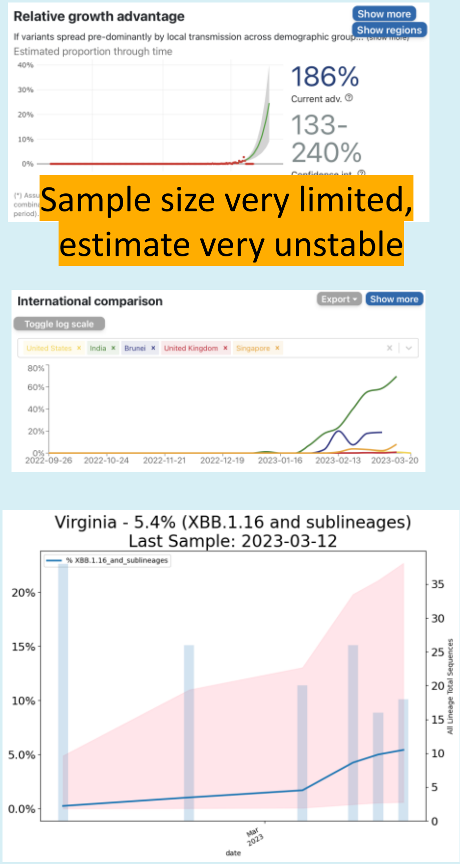
XBB.1.5



XBB.1.9*



XBB.1.16*



Sample size very limited, estimate very unstable

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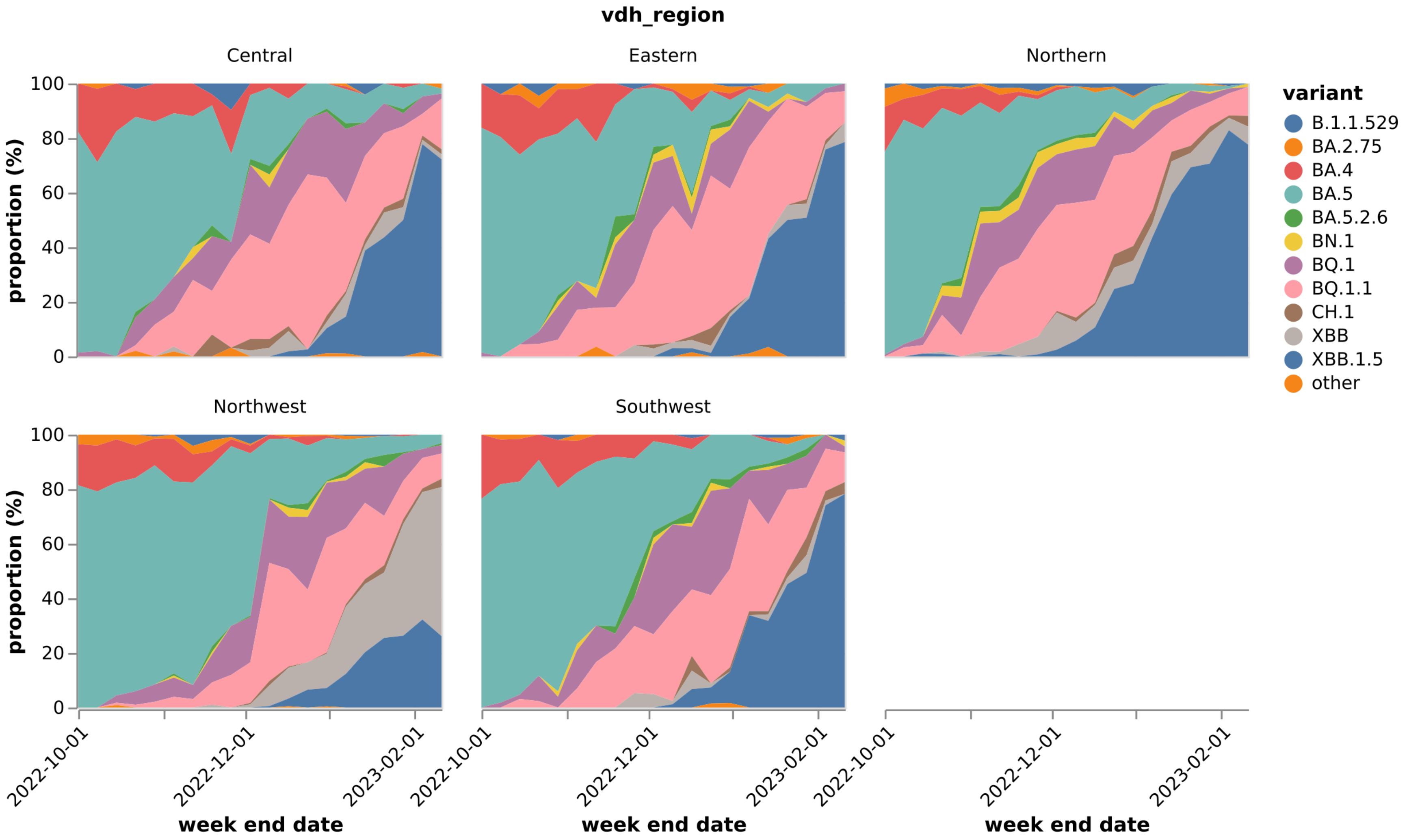
SARS-CoV2 Omicron Sub-Variants



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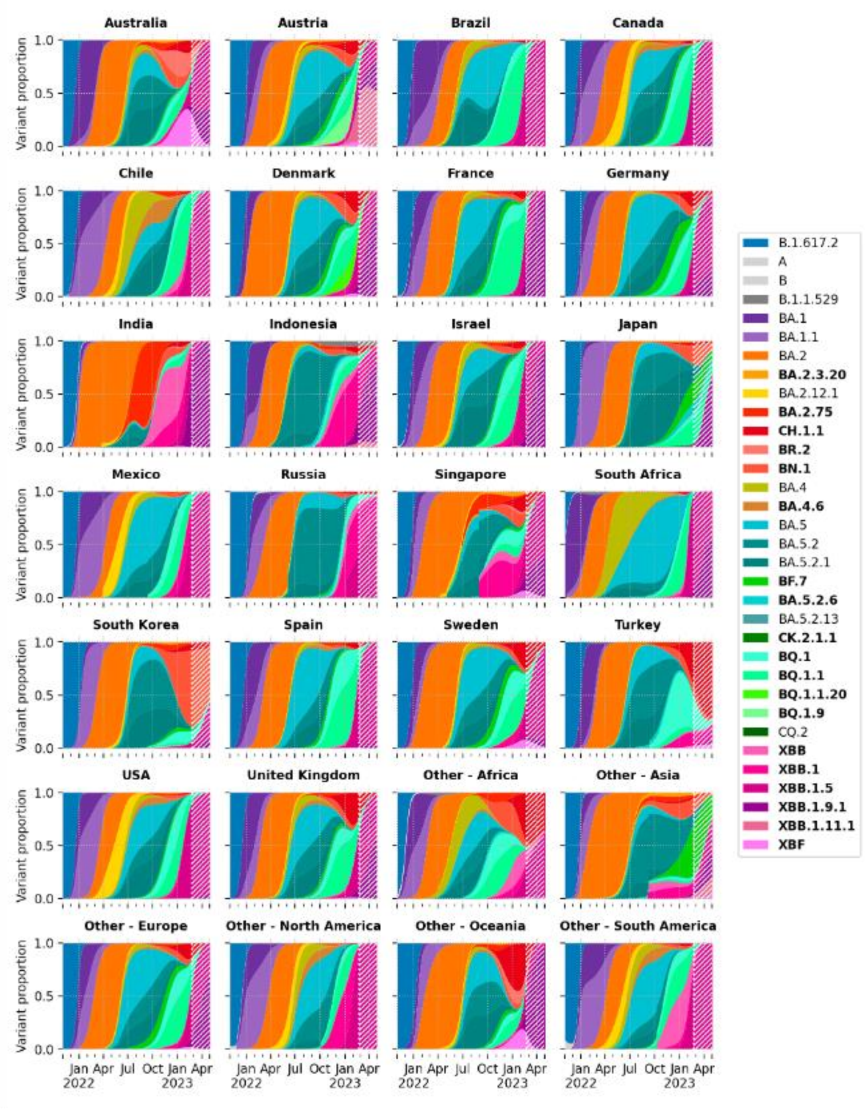
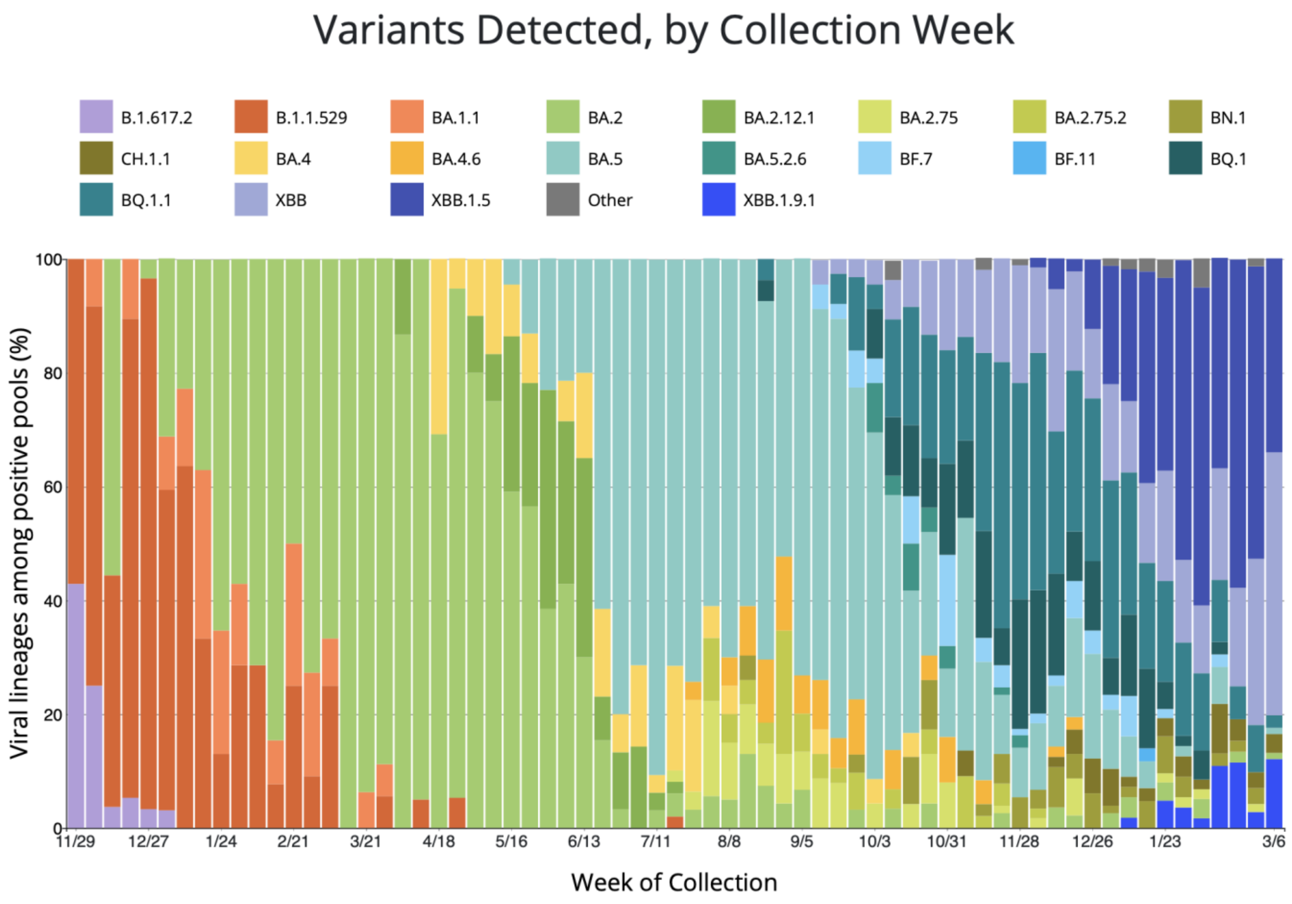
Global SARS-CoV2 Variant Status

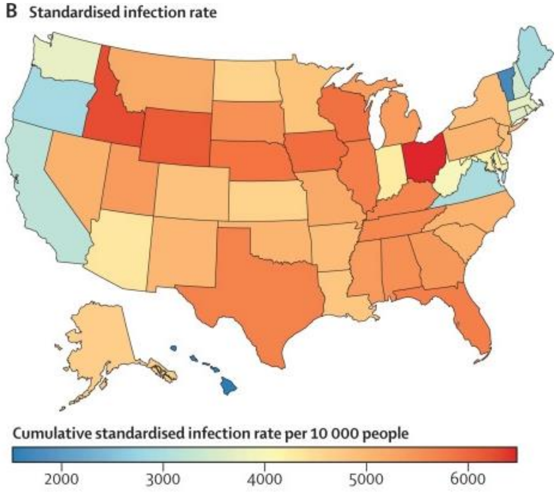


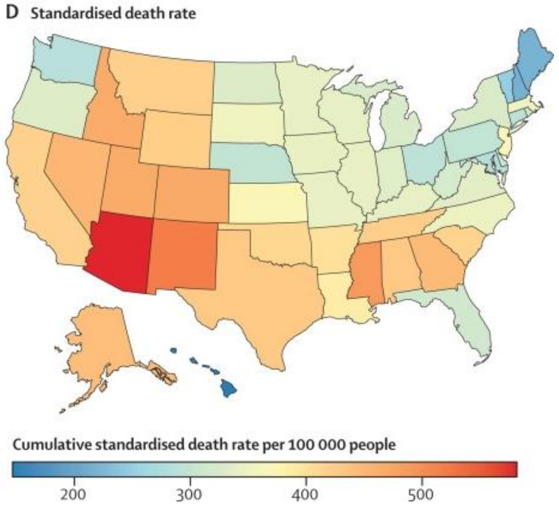


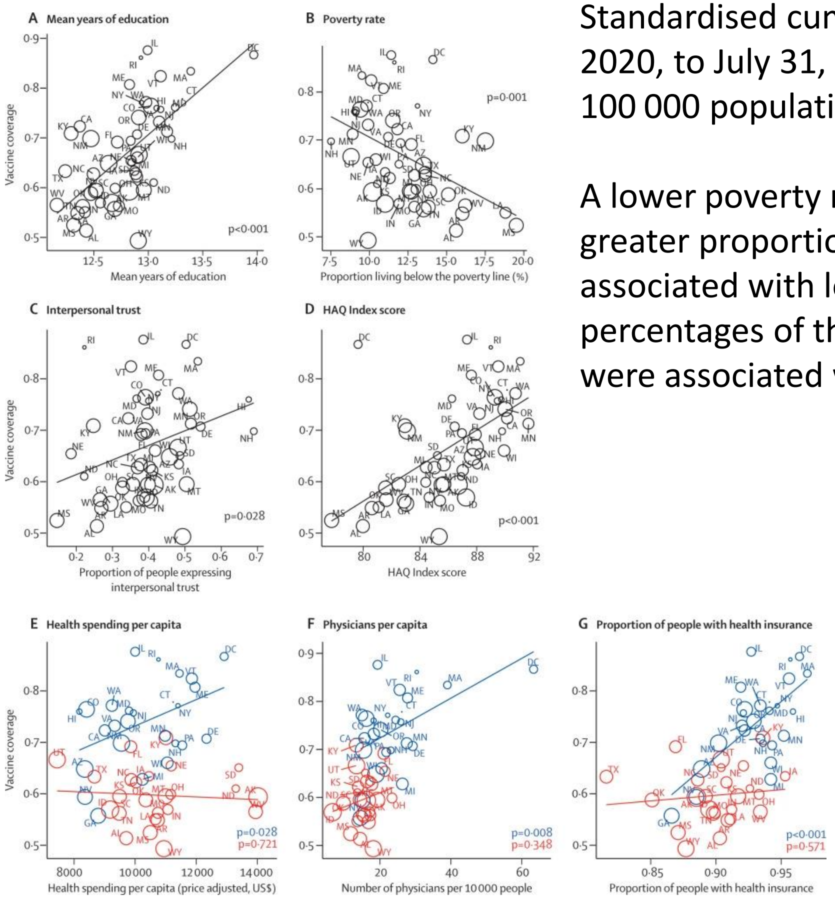
https://covid.cdc.gov/covid-data-tracker/#traveler-genomic-surveillance
https://github.com/gerstung-lab/SARS-CoV-2-International (02/09/23)

Pandemic Pubs (March 30th , 2023)

1. A comprehensive assessment of factors associated with standardized infection, hospitalization, and death rates were performed, including healthcare, social, and political factors that vary by state. Virginia's standardized death rate was lower than the national average. Many other outcomes and factors were assessed. [Lancet](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)00461-0/fulltext#)







Standardised cumulative COVID-19 death rates for the period from Jan 1, 2020, to July 31, 2022 varied across the USA (national rate 372 deaths per 100 000 population [95% uncertainty interval [UI] 364–379]),

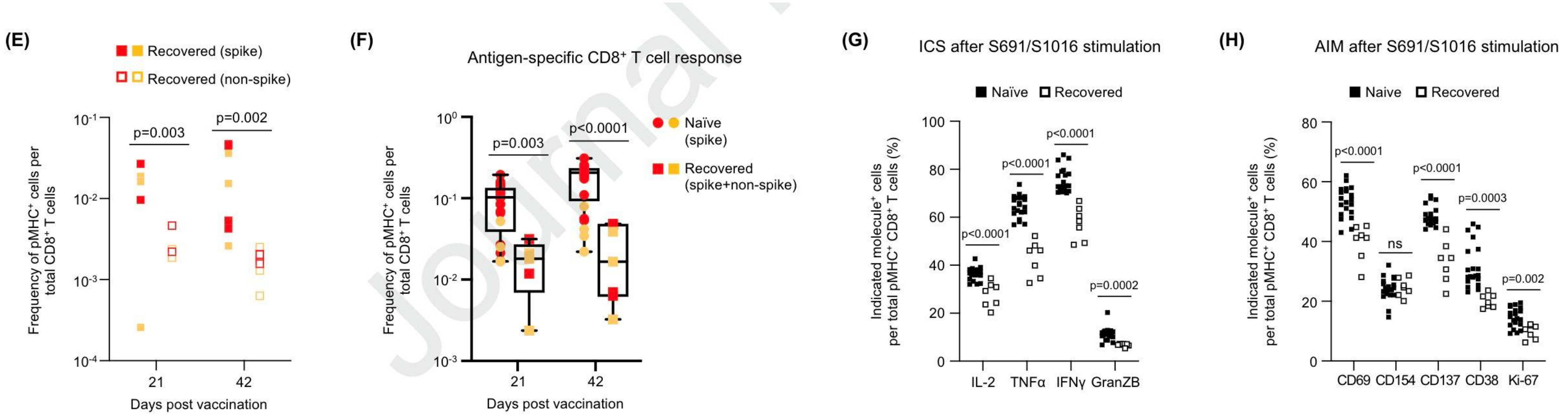
A lower poverty rate, higher mean number of years of education, and a greater proportion of people expressing interpersonal trust were statistically associated with lower infection and death rates, and states where larger percentages of the population identify as Black (non-Hispanic) or Hispanic were associated with higher cumulative death rates.

Access to quality health care (measured by the IHME's Healthcare Access and Quality Index) was associated with fewer total COVID-19 deaths and SARS-CoV-2 infections, but higher public health spending and more public health personnel per capita were not, at the state level. The political affiliation of the state governor was not associated with lower SARS-CoV-2 infection or COVID-19 death rates, but worse COVID-19 outcomes were associated with the proportion of a state's voters who voted for the 2020 Republican presidential candidate. State governments' uses of protective mandates were associated with lower infection rates, as were mask use, lower mobility, and higher vaccination rate, while **vaccination rates were associated with lower death rates**. State GDP and student reading test scores were not associated with state COVD-19 policy responses, infection rates, or death rates.

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)00461-0/fulltext#

Pandemic Pubs (March 22nd, 2023)

1. People with prior SARS-CoV-2 infection had a considerably lower magnitude and quality of a key immune cell's response to vaccination with two doses of the Pfizer-BioNTech COVID-19 vaccine compared to people without prior infection.



The researchers analyzed CD4+ and CD8+ T-cell responses in blood samples from three groups of volunteers. One group had never been infected with SARS-CoV-2 and received two doses of the Pfizer-BioNTech COVID-19 vaccine. The second group had previously been infected with SARS-CoV-2 and received two doses of the vaccine. The third group had COVID-19 and was unvaccinated.
The researchers found that people who had never been infected with SARS-CoV-2 and received two doses of the Pfizer-BioNTech COVID-19 vaccine had robust CD4+ and CD8+ T-cell responses to the virus' spike protein. **People who had been infected with SARS-CoV-2 prior to vaccination produced spike-specific CD8+ T cells at considerably lower levels—and with less functionality—than vaccinated people who had never been infected.** Moreover, unvaccinated people with COVID-19 had substantially lower levels of spike-specific CD8+ T cells than vaccinated people who had never been infected.

https://www.cell.com/immunity/fulltext/S1074-7613(23)00125-5

Pandemic Pubs (March 8th, 2023)

1. Two studies recently published in BMJ show effectiveness of vaccination in reducing risk of long COVID. [Byambasuren et al.] conducted a systematic review based on 16 studies and over 600K patients show a consistent pattern of protection with higher levels of vaccination. [Tran et al.] Conducted a paired cohort study of long COVID sufferers and measured a significant reduction in symptoms following vaccination.

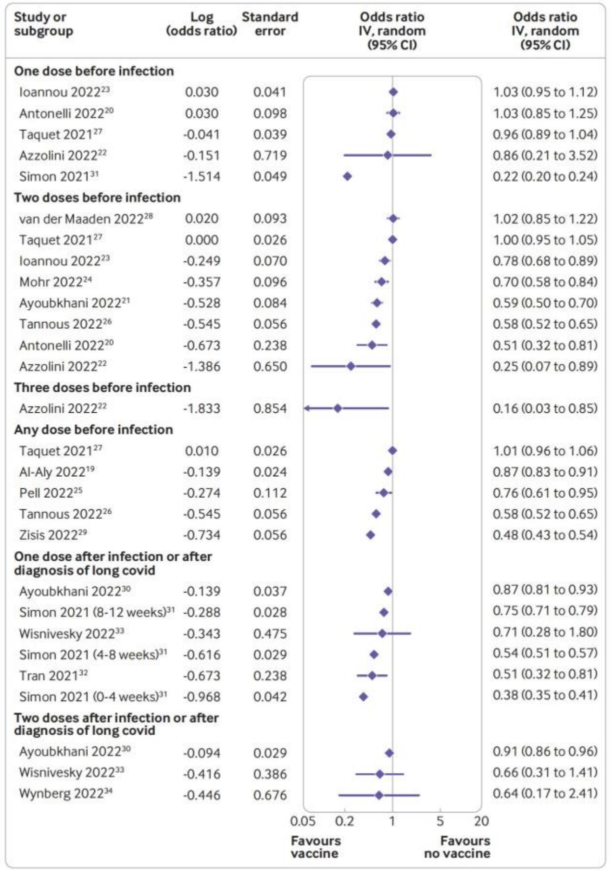
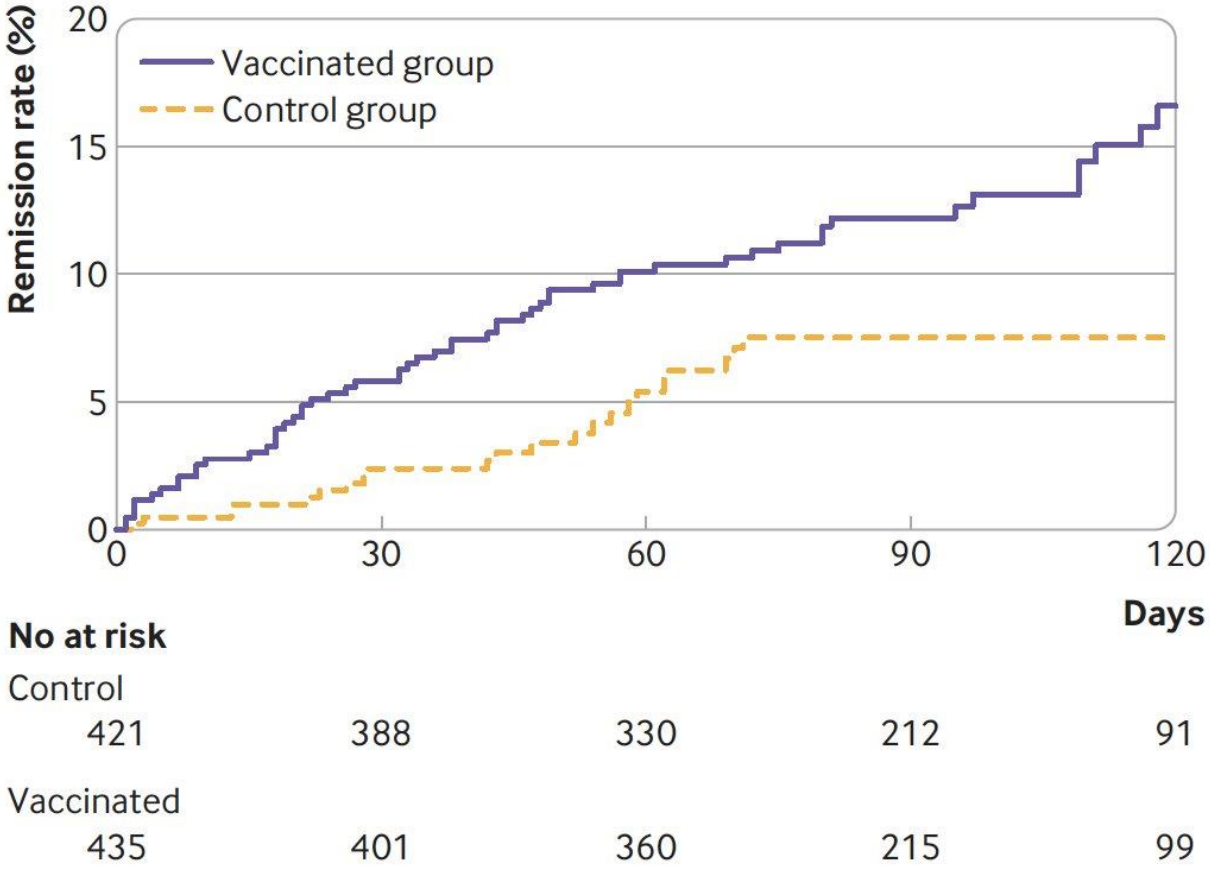


Figure 2 | Forest plot of the effect of covid-19 vaccine doses on long covid. Only relevant outcomes from all reported outcomes in individual studies were chosen. The ratios have a range of time frames (tables 1 and 2, and online supplemental file 3). IV=inverse variance

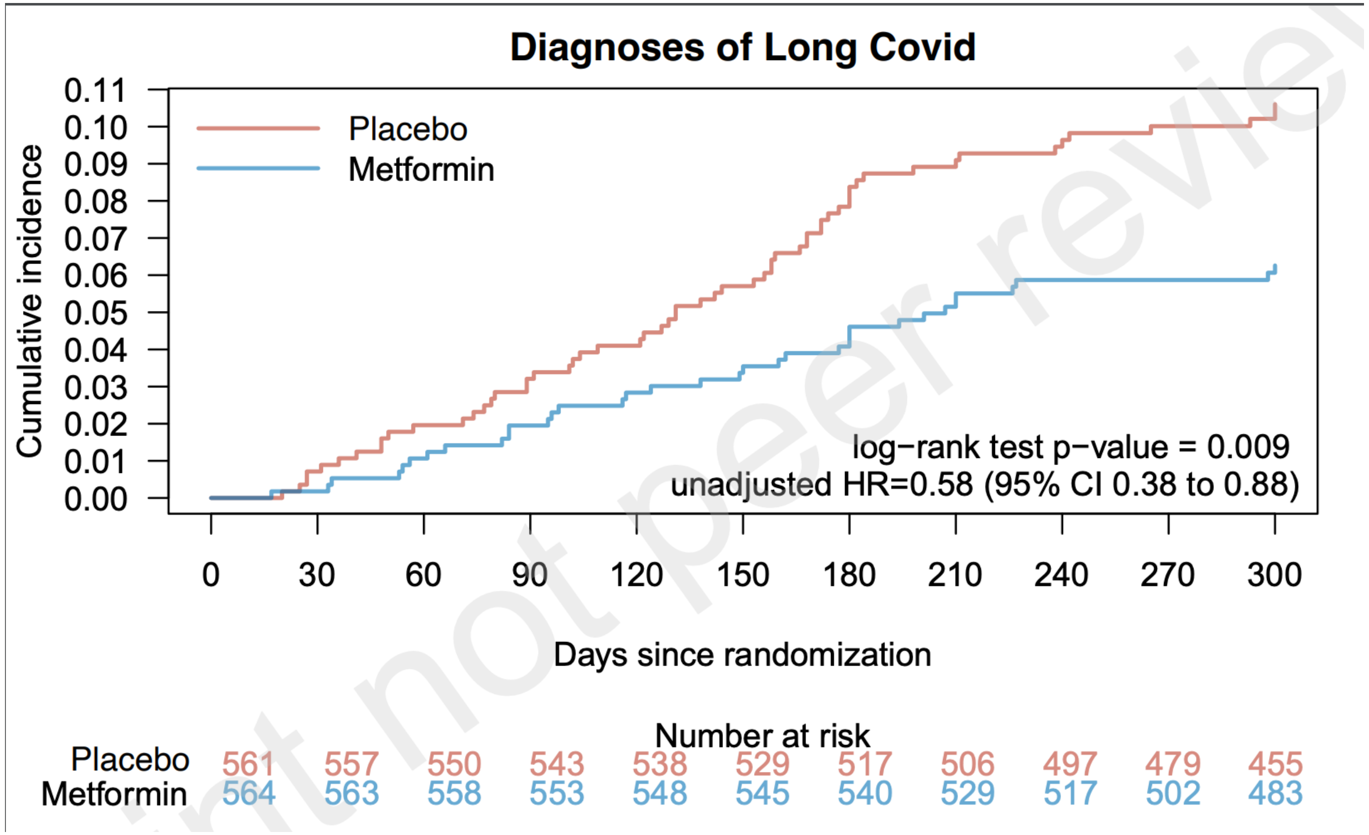
[Effect of covid-19 vaccination on long covid: systematic review]



[Efficacy of first dose of covid-19 vaccine versus no vaccination on symptoms of patients with long covid: target trial emulation based on ComPaRe e-cohort]

Pandemic Pubs (March 8th, 2023)

2. Study in Lancet demonstrates significant reduction in risk for developing long COVID through a randomized controlled trial of treatment with 6 days of Metformin (traditionally used to treat high blood sugar in diabetes) following COVID diagnosis



[Outpatient Treatment of COVID-19 and the Development of Long COVID Over 10 Months: A Multi-Center, Quadruple-Blind, Parallel Group Randomized Phase 3 Trial]

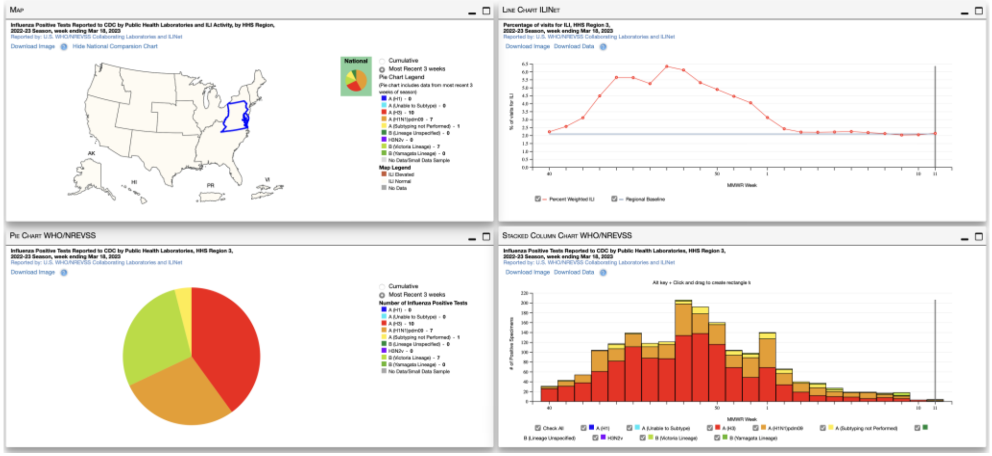
Influenza Update

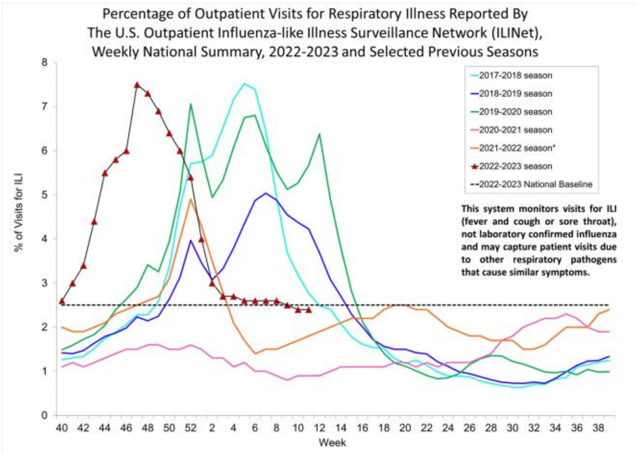
Current Influenza Situation – ILI Activity

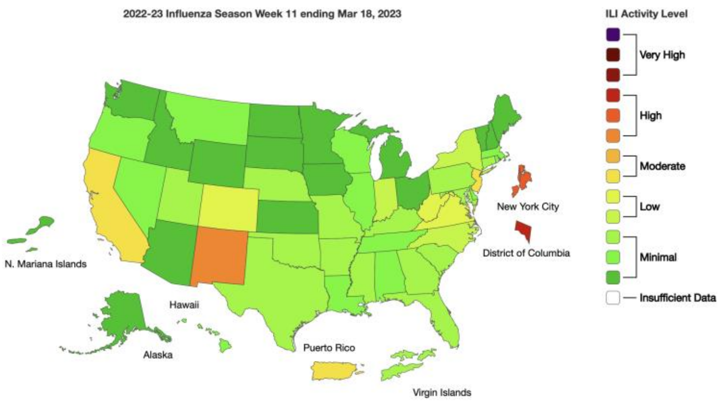
Influenza Activity finally falls below threshold

- Virginia remains is now at a ”Low” level as is most of the nation
- National ILI activity has also consistently declined since a peak in late November, and remains below threshold
- All regions and the nation are now below the seasonal threshold for ILI activity

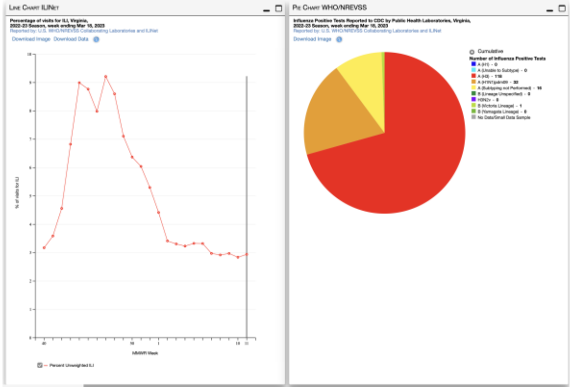
Region 3







Virginia



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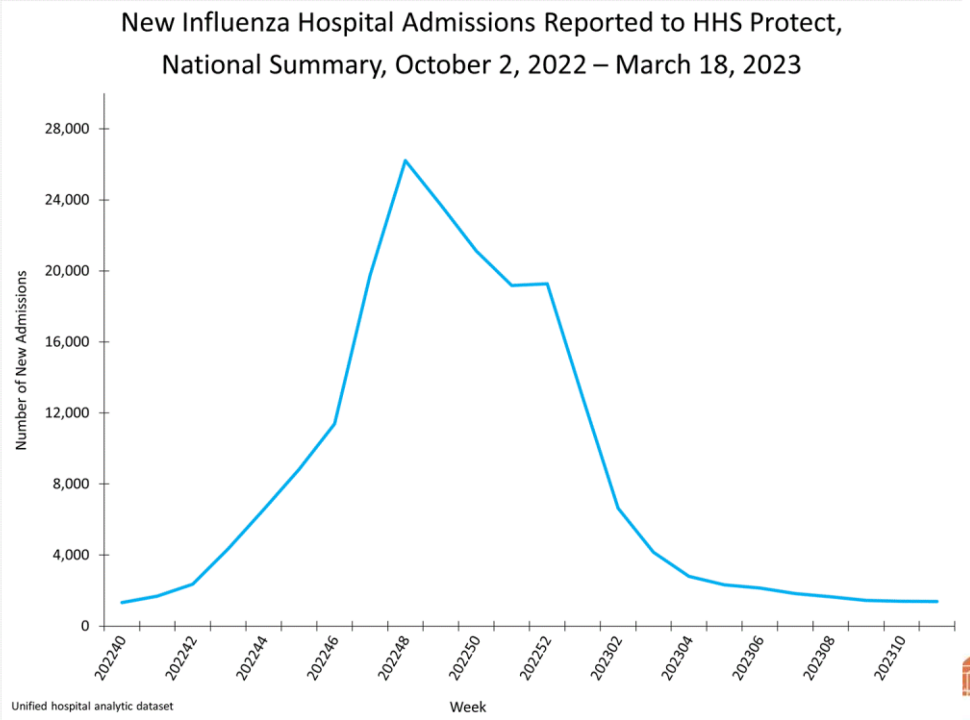
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

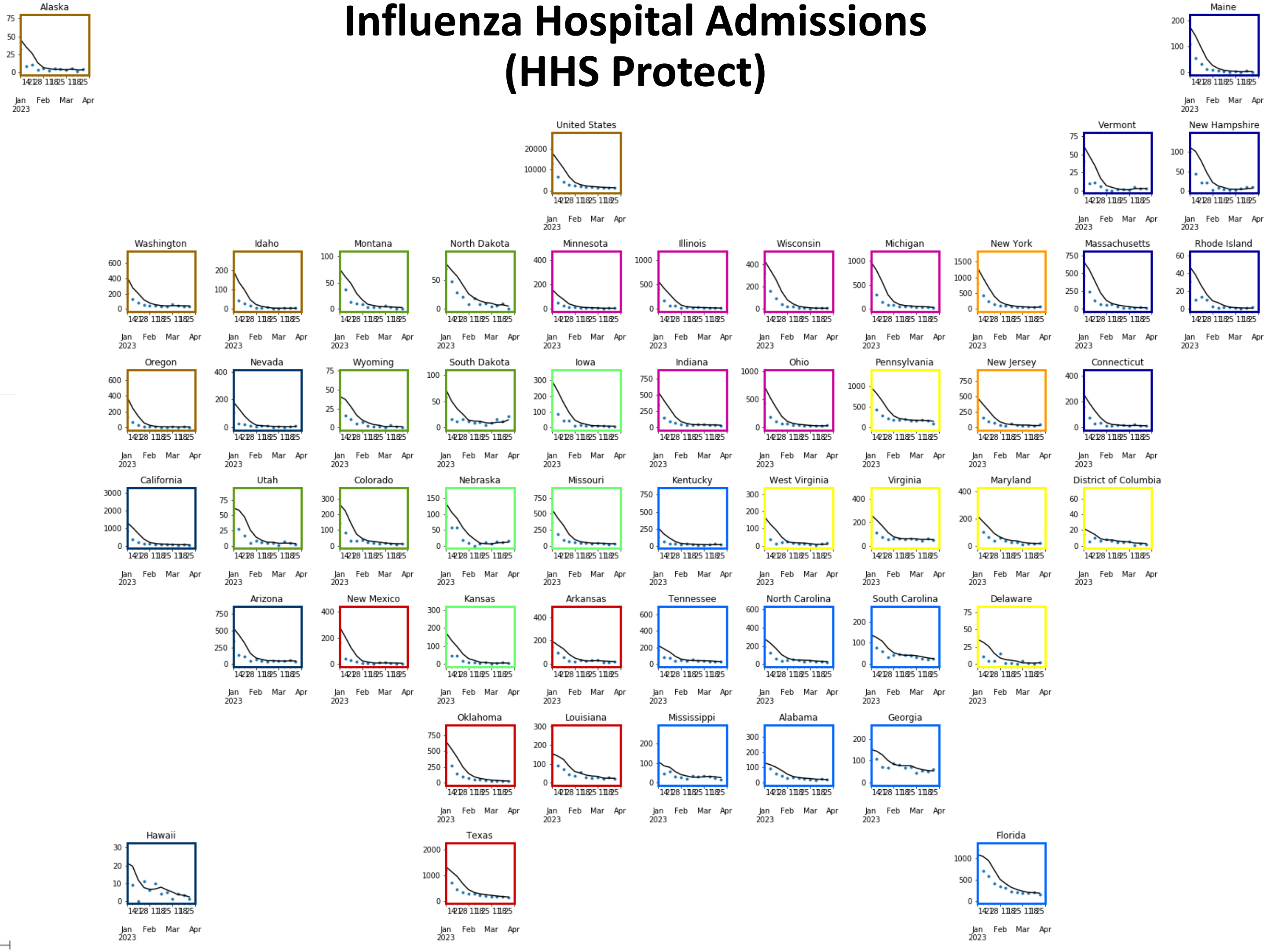
Current Influenza Situation - Hospitalizations

Influenza A hospitalizations continue decline

- National level of influenza hospitalizations have dropped to pre-season levels



Influenza Hospital Admissions (HHS Protect)



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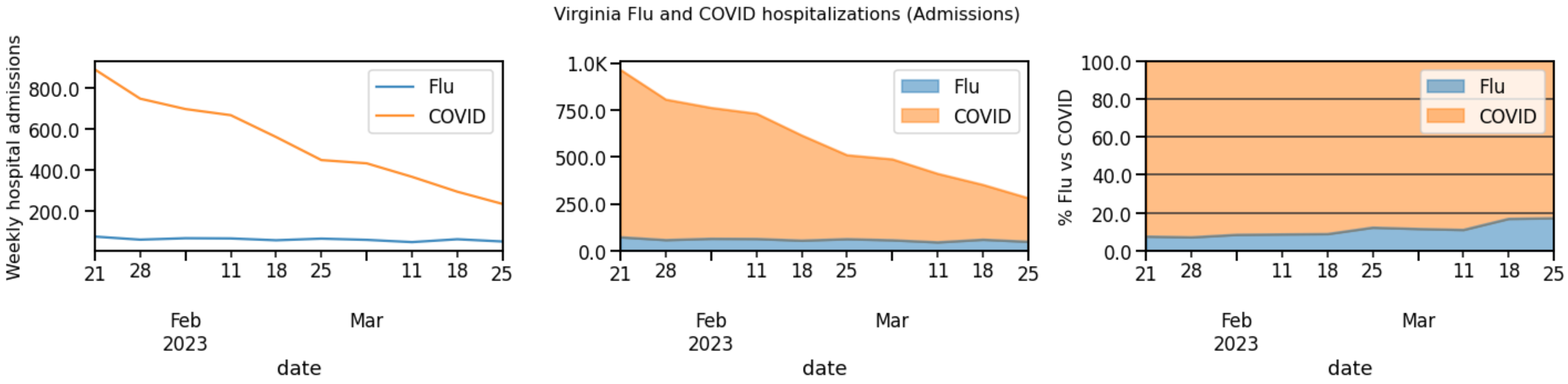
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

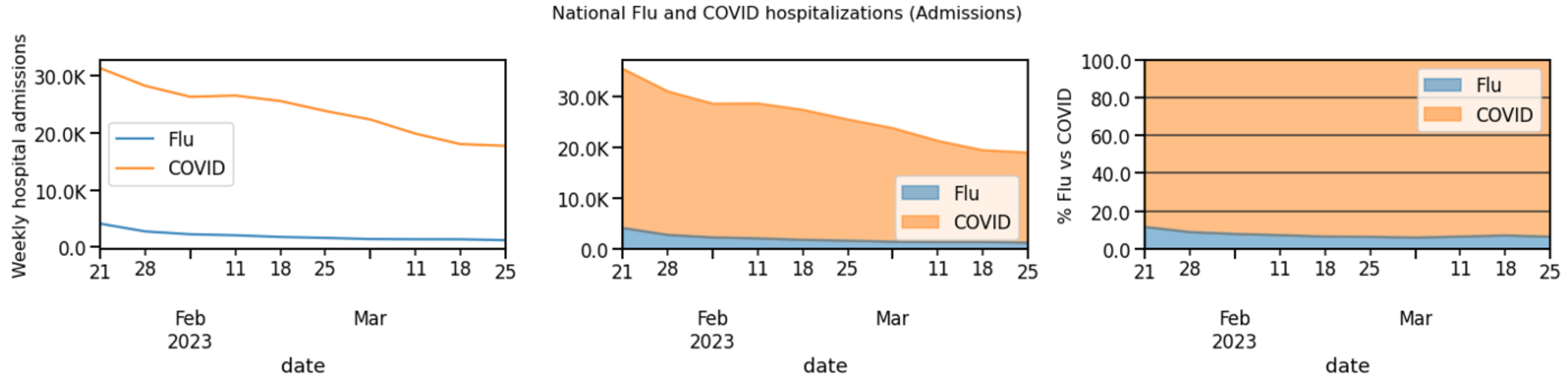
Current Combined Hospitalizations (COVID-19 & Influenza)

COVID-19 and Influenza Weekly Hospitalizations (HHS Protect)

Virginia



USA



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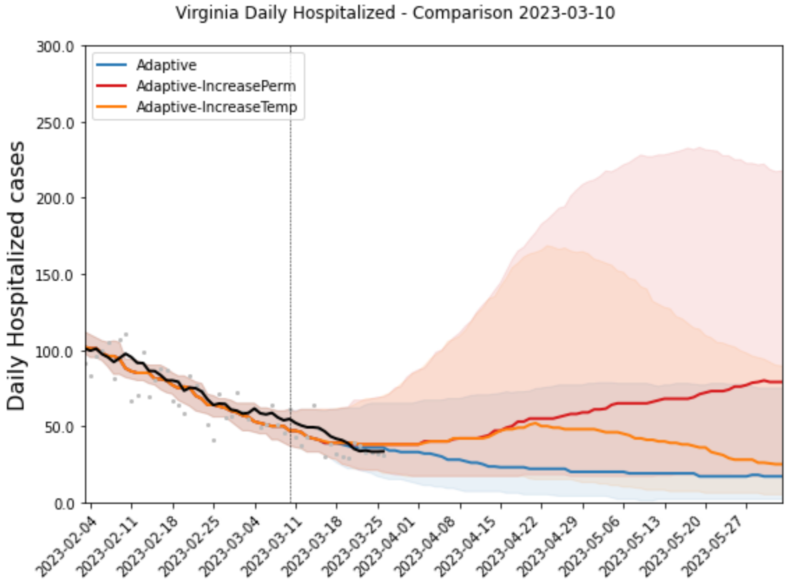
Model Results

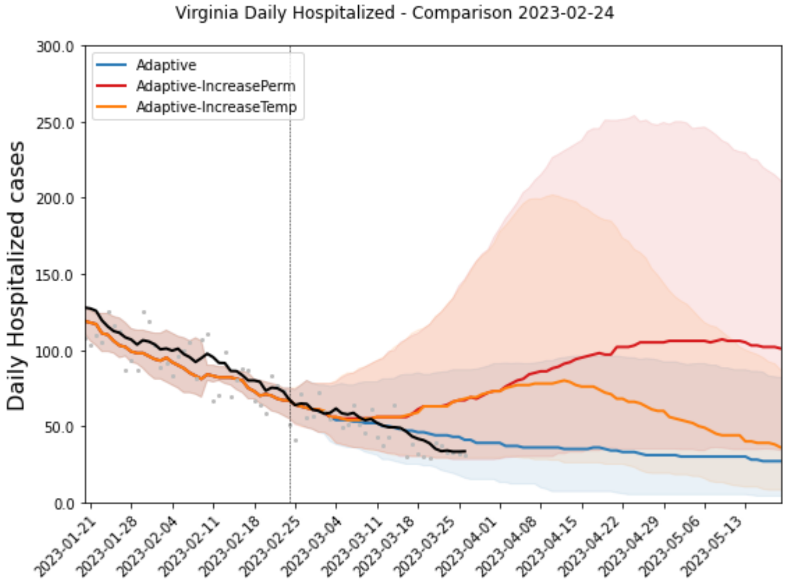
Previous projections comparison - Hospitalizations

- Previous projections have tracked observed hospitalizations well
- Past 6 weeks have stayed steady and indicate no increases in transmissions

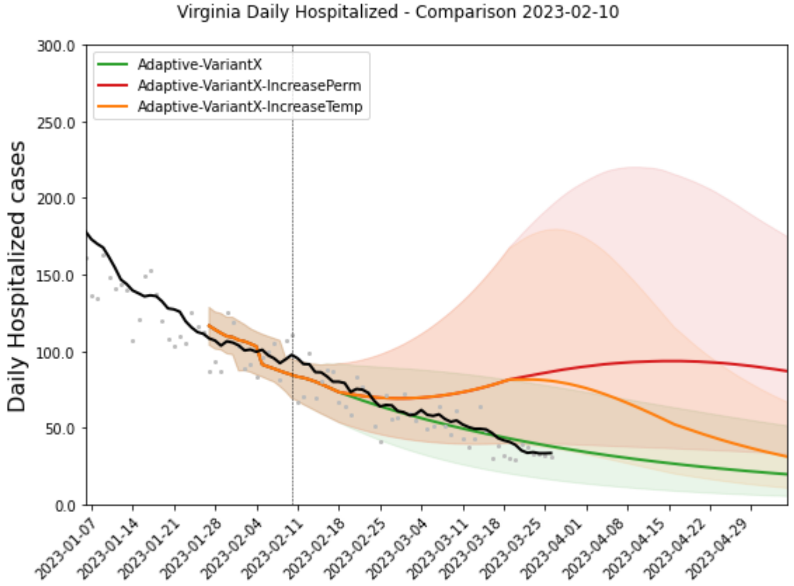
Previous round – 2 weeks ago



Previous round – 4 weeks ago



Previous round – 6 weeks ago



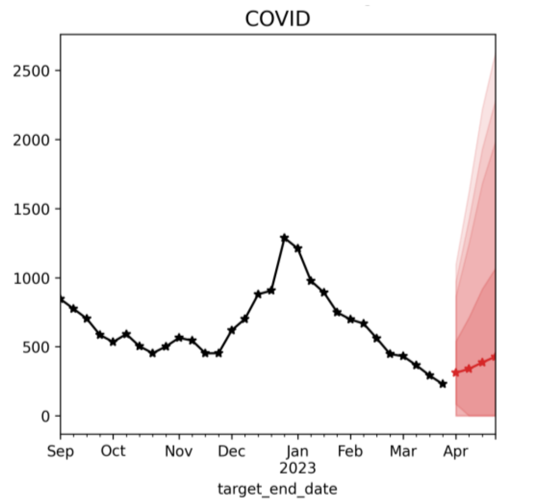
National Modeling Hub Updates

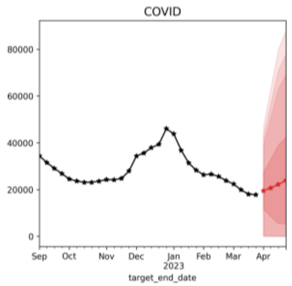
Current COVID-19 Hospitalization Forecast

Statistical models for submitting to CDC FluSight forecasting challenge

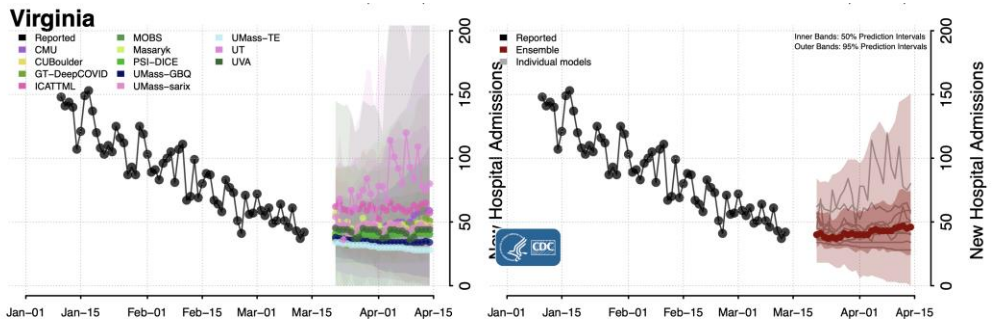
- Uses a variety of statistical and ML approaches to forecast weekly hospital admissions for the next 4 weeks for all states in the US

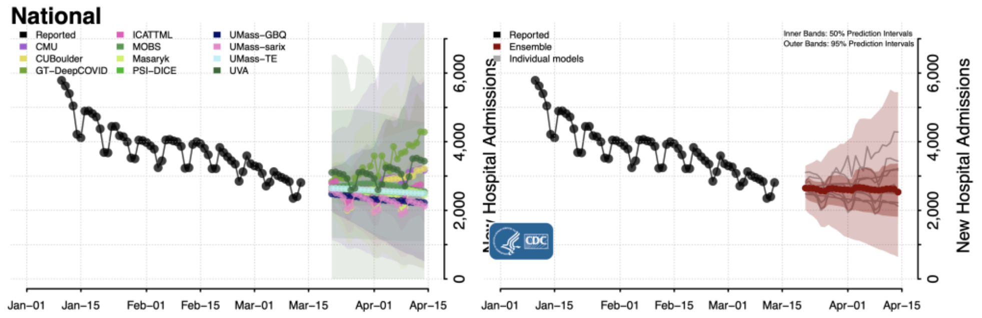
Hospital Admissions for COVID-19 and Forecast for next 4 weeks (UVA ensemble)





Hospital Admissions for COVID-19 and Forecast for next 4 weeks (CDC COVID Ensemble)





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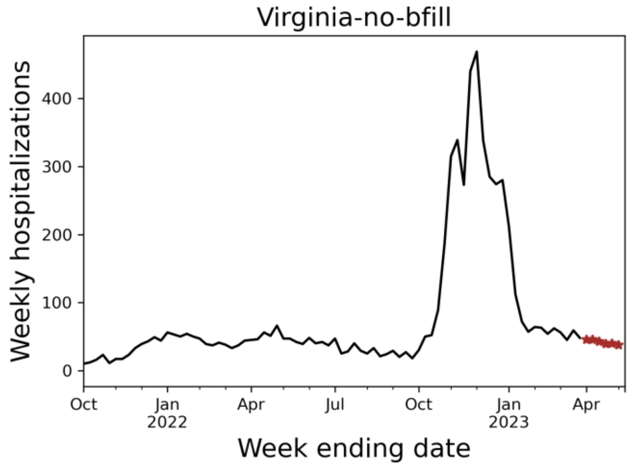
CDC [CDC COVID Forecast]

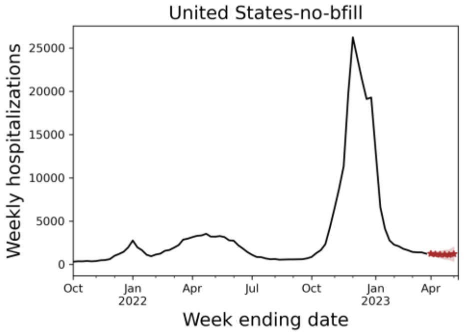
Current Influenza Hospitalization Forecast

Statistical models for submitting to CDC FluSight forecasting challenge

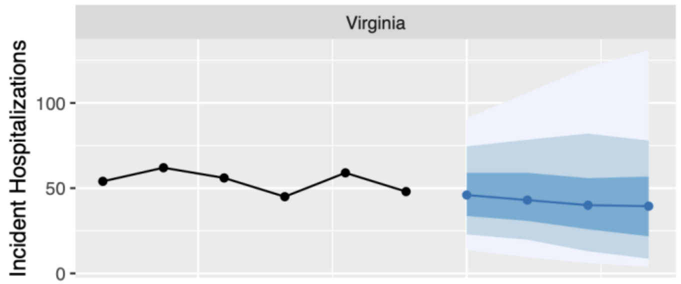
- Similar to COVID-19 case forecasts, uses a variety of statistical and ML approaches to forecast weekly hospital admissions for the next 4 weeks for all states in the US

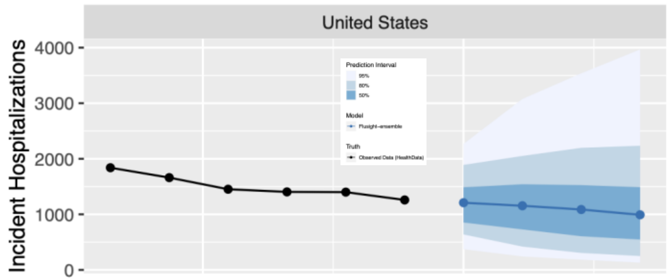
Hospital Admissions for Influenza and Forecast for next 4 weeks (UVA ensemble)





Hospital Admissions for Influenza and Forecast for next 4 weeks (CDC FluSight Ensemble)





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CDC FluSight

Combined ILI and COVID-19 Hospitalizations

Ensemble methodology that combines the Adaptive with machine learning and statistical models such as:

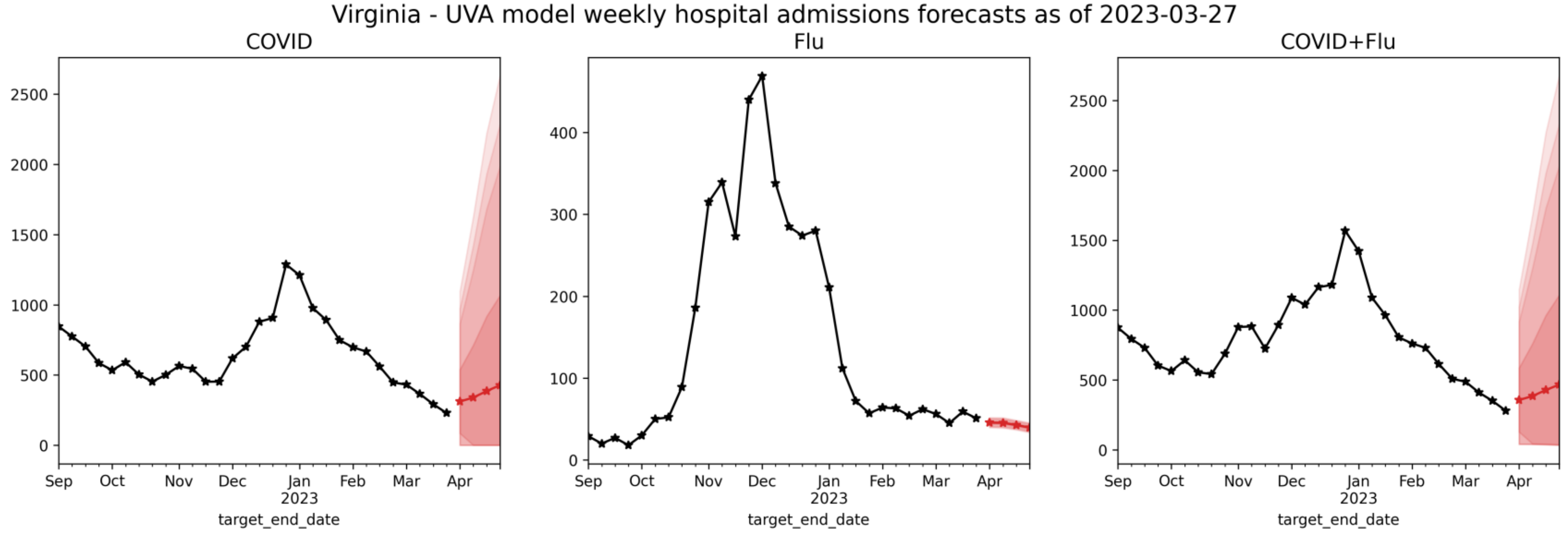
- Autoregressive (AR, ARIMA) , Neural networks (LSTM), Kalman filtering (EnKF), G-model (phase), Holt-Winters

<u>Weekly forecasts of hospitalizations</u> done at state level.

Models chosen because of their track record in disease forecasting and to increase diversity and robustness.

Both are regularly submitted to CDC Forecast Hubs

Weekly Hospitalizations
Short-term COVID-19 and Influenza Forecasts



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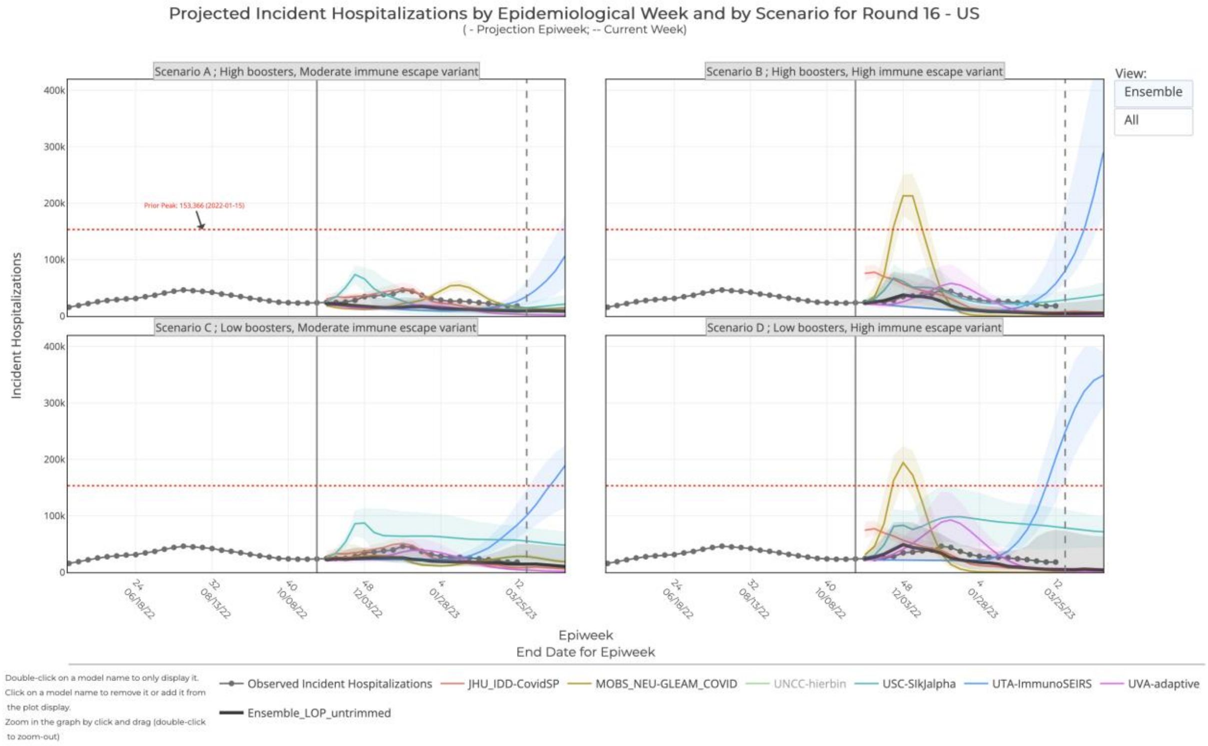
Scenario Modeling Hub – COVID-19 (Round 16)

Collaboration of multiple academic teams to provide national and state-by-state level projections for 4 aligned scenarios

- Round 16 results published
- Moderate escape scenarios tracking best

https://covid19scenariomodelinghub.org/viz.html

	"Level 5" Variants	"Level 6/7" Variants
Accelerating uptake levels of reformulated boosters	Scenario A "Level 5" Variants - Variants have a 25% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 5 variants at the start of the projection period - No change in severity given symptomatic infection Accelerating uptake levels of reformulated boosters, with coverage plateauing at 90% of flu vaccination levels by February 1st, 2023 - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2022 plateau	Scenario B "Level 6/7" Variants - Variants have a 50% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 6 and 7 variants at the start of the projection period - No change in severity given symptomatic infection Accelerating uptake levels of reformulated boosters, with coverage plateauing at 90% of flu vaccination levels by February 1st, 2023 - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2022 plateau
Current uptake levels of reformulated boosters	Scenario C "Level 5" Variants - Variants have a 25% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 5 variants at the start of the projection period - No change in severity given symptomatic infection Current uptake levels of reformulated boosters, with coverage plateauing at booster 1 levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Based on current rates, plateau date is flexible as long as it occurs before the end of the simulation (Teams can adjust rates up if needed to achieve adequate coverage by target date)	Scenario D "Level 6/7" Variants - Variants have a 50% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 6 and 7 variants at the start of the projection period - No change in severity given symptomatic infection Current uptake levels of reformulated boosters, with coverage plateauing at booster 1 levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Based on current rates, plateau date is flexible as long as it occurs before the end of the simulation (Teams can adjust rates up if needed to achieve adequate coverage by target date)



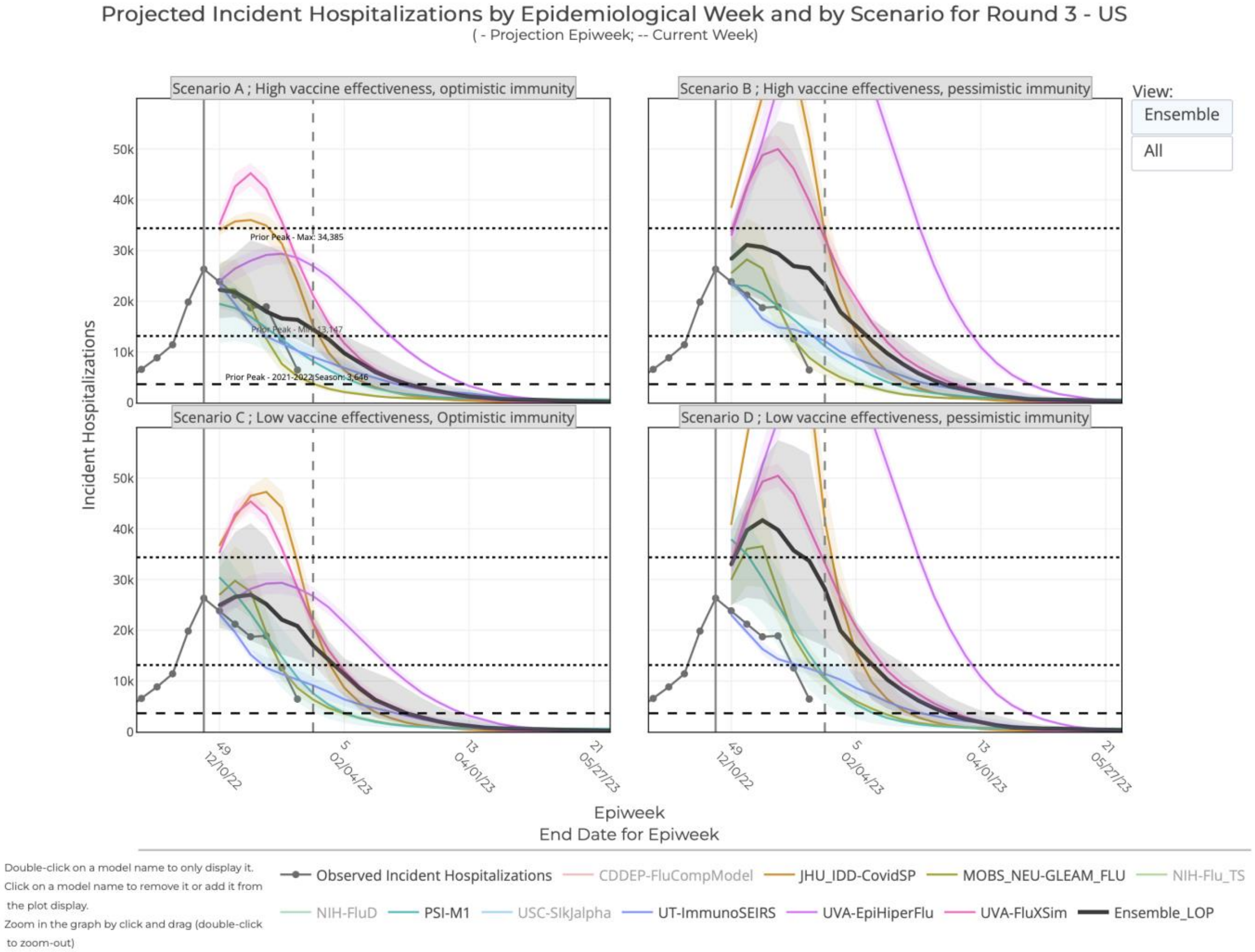
Scenario Modeling Hub – Influenza (Round 3)

Collaboration of multiple academic teams to provide national and state-by-state level projections for 4 aligned scenarios

- All rounds so far have explored the combination of a prior immunity axis and a vaccine effectiveness axis
- Round 2 and 3 are identical in design (Round 3 cutoff December 3rd)

	Optimistic flu prior immunity	Pessimistic flu prior immunity
High Vaccine Effectiveness	Scenario A Optimistic flu prior immunity - No impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - Same amount of prior immunity as in a typical, pre-COVID19 pandemic prior season. High Vaccine Effectiveness - VE = 50% against medically attended influenza illnesses and hospitalizations (comparable to 2015-16 season).	Scenario B Pessimistic flu prior immunity - Substantial impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - 50% lower immunity than a typical, pre-COVID19 pandemic season. High Vaccine Effectiveness - VE = 50% against medically attended influenza illnesses and hospitalizations (comparable to 2015-16 season).
Low Vaccine Effectiveness	Scenario C Optimistic flu prior immunity - No impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - Same amount of prior immunity as in a typical, pre-COVID19 pandemic prior season. Low Vaccine Effectiveness - VE = 30% against medically attended influenza illnesses and hospitalizations (comparable to 2018-19 season).	Scenario D Pessimistic flu prior immunity - Substantial impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - 50% lower immunity than a typical, pre-COVID19 pandemic season. Low Vaccination Protection - VE = 30% against medically attended influenza illnesses and hospitalizations (comparable to 2018-19 season).

https://fluscenariomodelinghub.org/viz.html



Key Takeaways

Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

- Case rates and hospitalizations from COVID-19 continue decline but rate is slowing towards a plateau
  - Hospital occupancy down to levels last seen in early May of 2022
- Influenza hospitalizations remain very low and ILI activity remains below seasonal threshold

Model Updates

- Projected Trajectories from previous rounds remain on target, no new projections made this round

Questions?

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